GE Healthcare

Corometrics™ 250cx Series Monitor
Operator's Manual

Corometrics 250cx Series Monitor
English
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Our obligation under this guarantee is limited to repairing, or, at our option, replacing any defective parts of our equipment, except fuses or batteries, without charge, if such defects occur in normal service.

Claims for damage in shipment should be filed promptly with the transportation company. All correspondence covering the instrument should specify the model and serial numbers.

GE MEDICAL SYSTEMS *Information Technologies*
A GE Healthcare Company

GE Medical Systems *Information Technologies* will make available on request such circuit diagrams, component diagrams, component parts lists, descriptions, calibration instructions, or other information which will assist the users or appropriately qualified technical personnel to repair those parts of the equipment which are classified by GE Medical Systems *Information Technologies* as repairable. Refer to the *250/250cx Series Service Manual* for further information.

NOTE: In addition to software version 4.50, the information in this manual also applies to previous software revisions of Corometrics 250cx Series Monitor. There are no user-apparent differences among these software versions. Due to continuing product innovation, specifications in this manual are subject to change without notice.

NOTE: For technical documentation purposes, the abbreviation GE is used for the legal entity name, GE Medical Systems *Information Technologies*

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CE Marking Information

CE 0459

Compliance

A GE brand Corometrics 250cx Series Monitor bears CE mark CE-0459 indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive.

The device is manufactured in India; the CE mark is applied under the authority of Notified Body GMED (0459).

The country of manufacture and appropriate Notified Body can be found on the equipment labeling.

The product complies with the requirements of standard EN 60601-1-2 "Electromagnetic Compatibility—Medical Electrical Equipment" and standard EN 60601-1 "General Requirements for Safety."

Components of the Certified Systems

The IEC electromagnetic compatibility (EN) standards require individual equipment (components and accessories) to be configured as a system for evaluation. For systems that include a number of different equipments that perform a number of functions, one of each type of equipment shall be included in the evaluation.

The equipment listed below is representative of all possible combinations. For individual equipment certification, refer to the appropriate declarations of conformity.

Component Description:

- 250cx Series Maternal/Fetal Monitor
- Model 146 Fetal Acoustic Stimulator
- Intrauterine Pressure Transducer
- TOCO Transducer
- FECG Cable/Legplate
- Ultrasound Transducers (x2)
- Blood Pressure Hose and Cuff
- MSpO$_2$ Interconnect Cable and Sensor
- MECG Cable
- FECG/MECG Adapter Cable
- Remote Event Marker
- RS-232C Interconnect Cables (x3)
- Central Nurses Station Interconnect Cable
- Model 2116B Keyboard and Interconnect Cable
- Model 1563AAO Telemetry Cable
- Exergen TemporalScanner™ TAT-5000 Assembly 2036641-001

Exceptions

The Monitor System EMC: Immunity Performance

None

Be aware that adding accessories or components, or modifying the medical device or system may degrade the EMI performance. Consult with qualified personnel regarding changes to the system configuration.

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1 Safety

For your notes

General Information

General Use

If the monitor is cold to the touch or below ambient temperature, allow it to stabilize before use.

To ensure patient safety, use only parts and accessories manufactured or recommended by GE Medical Systems *Information Technologies*. Parts and accessories used shall meet the requirements of EN60601-1-1.

Disposable devices are intended for single use only. They should not be reused.

Test all functions periodically and whenever the integrity of the monitor is in doubt.

Refer to the “Maternal/Fetal Monitoring, Clinical Applications Manual” for information concerning the limitations of internal and external fetal heart rate monitoring techniques.

Responsibility of the Manufacturer

GE Medical Systems *Information Technologies* is responsible for the effects on safety, reliability, and performance if:

- assembly operations, extensions, readjustments, modifications, or repairs are carried out by persons authorized by GE Medical Systems *Information Technologies*;
- the electrical installation of the relevant room complies with the requirements of appropriate regulations; and
- the monitor is used in accordance with the instructions of use.

Responsibility of the User

This device is intended for use by clinical professionals who are expected to know the medical procedures, practices, and terminology required to monitor obstetrical patients. This manual documents all possible parameters available in the 250cx Series monitor. It is the responsibility of each hospital to ensure that the Labor and Delivery staff is trained in all aspects of the selected model.

The 250cx Series monitor is only one clinical indicator of fetal status during labor. The monitor is designed to assist the perinatal staff in assessing the status of a patient. The monitor does not replace observation and evaluation of the mother and fetus at regular intervals by a qualified care provider, who will make diagnoses and decide on treatments or interventions. Visual assessment of the monitor display and strip chart must be combined with knowledge of patient history and risk factors to properly care for the mother and fetus.

Definitions of Terminology

Six types of special notices are used *throughout* this manual. They are: Danger, Warning, Caution, Contraindication, Important, and Note. The warnings and cautions in this Safety section relate to the equipment in general and apply to all aspects of the monitor. Be sure to read the other chapters because there are additional warnings and cautions which relate to specific features of the monitor.

When grouped, warnings and cautions are listed alphabetically and do not imply any order of importance.

Definitions of Terminology	
Danger	A DANGER notice indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
Warning	A WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.
Caution	A CAUTION indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Cautions are also used to avoid damage to equipment.
Contraindication	A CONTRAINDICATION describes any special symptom or circumstance that renders the use of a remedy or the carrying out of a procedure inadvisable, usually because of a risk.
Important	An IMPORTANT notice indicates an emphasized note. It is something you should be particularly aware of; something not readily apparent.
Note	A NOTE indicates a particular point of information; something on which to focus your attention.

Fetal Monitoring Indications for Use

A Corometrics 250cx Series Fetal Monitor is used for fetal surveillance.

Surveillance

A Corometrics 250cx Series monitor can be used for routine non-invasive and invasive fetal monitoring throughout labor and delivery.

Maternal Monitoring Indications for Use

A Corometrics 250cx Series Maternal/Fetal Monitor is intended for monitoring maternal vital signs to help assess maternal well-being. The vital signs which can be measured are summarized below.

NOTE: Maternal vital signs provided by the monitor should only be used as an adjunct to patient assessment and must be used in conjunction with clinical signs and symptoms.

Blood Pressure

The monitor is intended for use only in the non-invasive monitoring of maternal blood pressure (NIBP). This monitor is not intended for use in neonatal or pediatric blood pressure monitoring.

Pulse Oximetry

The monitor is intended for use in the non-invasive monitoring of the functional oxygen saturation of maternal arterial blood ($MSpO_2$).

Heart/Pulse Rate

The monitor is intended for use in the non-invasive monitoring of the maternal heart/pulse rate (MHR/P).

NOTE: The Corometrics 250cx Series provides both maternal *heart* rate and maternal *pulse* rate data; the *heart* rate data is derived from the MECG section of the monitor while the *pulse* rate data is derived from the NIBP or $MSpO_2$ sections of the monitor.

Monitor Contraindications, Warnings, and Precautions

Warnings

WARNINGS

ACCIDENTAL SPILLS—In the event that fluids are accidentally spilled onto the monitor, remove the monitor from operation and inspect for damage.

APPLICATION—This monitor is not designed for direct cardiac connection.

CONDUCTIVE CONNECTIONS—Avoid making any conductive connections to applied parts (patient connection) which are likely to degrade safety.

CONDUCTIVE PARTS—Ensure that the conductive parts of the lead electrodes and associated connectors do not contact other conductive parts including earth.

CONNECTIONS—The correct way to connect a patient to the monitor is to plug the electrode leads into the patient cable which in turn connects to the monitor. The monitor is connected to the wall socket by the power cord. Do not plug the electrode leads into the power cord, a wall socket, or an extension cord.

DEFIBRILLATION—During defibrillation, all personnel must avoid contact with the patient and monitor to avoid a dangerous shock hazard. In addition, proper placement of the paddles in relation to the electrodes is required to minimize harm to the patient.

DEFIBRILLATION PROTECTION—When used with the GE Medical Systems *Information Technologies*-recommended accessories, the monitor is protected against the effects of defibrillator discharge. If monitoring is disrupted by the defibrillation, the monitor will recover.

ELECTRICAL SHOCK—To reduce the risk of electrical shock, do not remove monitor cover. Refer servicing to qualified personnel.

ELECTROMAGNETIC INTERFERENCE—Be aware that strong electromagnetic fields may interfere with monitor operation. Interference prevents the clear reception of signals by the monitor. If the hospital is close to a strong transmitter such as TV, AM or FM radio, police or fire stations, a HAM radio operator, an airport, or cellular phone, their signals could be picked up as monitor signals. If you feel interference is affecting the monitor, contact your Service Representative to check the monitor in your environment. Refer to “Electromagnetic Interference” on page 1-10 for additional information.

WARNINGS

ELECTROSURGERY—The monitor is not designed for use with high-frequency surgical devices. In addition, measurements may be affected in the presence of strong electromagnetic sources such as electrosurgery equipment.

EQUIPMENT USE—The use of this equipment is restricted to one patient at a time.

EXPLOSION HAZARD—Do not use this equipment in the presence of flammable anesthetics or inside an oxygen tent.

GROUNDING—Do not defeat the three-wire grounding feature of the power cord by means of adaptors, plug modifications, or other methods. A dangerous shock hazard to both patient and operator may result.

INOPERABLE MECG—The MECG trace is not visible during a MECG LEADS OFF condition or an overload (saturation) of the front-end amplifier during differential input voltage of more than ± 300mV.

INSTRUCTIONS—For continued and safe use of this equipment, it is necessary to follow all listed instructions. However, the instructions provided in this manual in no way supersede established medical procedures concerning patient care. The monitor does not replace observation and evaluation of the patient, at regular intervals, by a qualified care provider who will make diagnoses and decide on treatments and interventions.

INTERFACING OTHER EQUIPMENT—Monitoring equipment must be interfaced with other types of medical equipment by qualified biomedical engineering personnel. Be certain to consult manufacturers' specifications to maintain safe operation.

LEAKAGE CURRENT TEST—The interconnection of auxiliary equipment with this device may increase the total leakage current. When interfacing with other equipment, a test for leakage current must be performed by qualified biomedical engineering personnel before using with patients. Serious injury or death could result if the leakage current exceeds applicable standards. The use of accessory equipment not complying with the equivalent safety requirements of this equipment may lead to a reduced level of safety of the resulting system. Consideration relating to the choice shall include: use of the accessory in the patient vicinity; and evidence that the safety certification of the accessory has been performed in accordance with the appropriate EN60601.1 and/or EN60601.1.1 harmonized national standard.

LINE ISOLATION MONITOR TRANSIENTS—Line isolation monitor transients may resemble actual cardiac waveforms, and thus cause incorrect heart rate determinations and alarm activation (or inhibition).

WARNINGS

MRI USE—Do not use the electrodes during MRI scanning; conducted current could potentially cause burns.

PATIENT CABLES AND LEADWIRES—Do not use patient cables and electrode leads that permit direct connection to electrical sources. Use only “safety” cables and leadwires. Use of non-safety patient cables and lead wires creates risk of inappropriate electrical connection which may cause patient shock or death.

PACEMAKER PATIENTS—Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance. Refer to Chapter 16, “Troubleshooting” for disclosure of the pacemaker pulse rejection capability of the 250cx Series Monitor.

RF INTERFACE—Known RF sources, such as cell phones, radio or TV stations, and two-way radios, may cause unexpected or adverse operation of this device.

SIMULTANEOUS DEVICES—Do not simultaneously connect more than one device that uses electrodes to detect ECG and/or respiration to the same patient. Use of more than one device in this manner may cause improper operation of one or more of the devices.

STRANGULATION—Make sure all patient cables, leadwires, and tubing are positioned away from the patient’s head to minimize the risk of accidental strangulation.

WATER BIRTHS—Do not use the monitor to directly monitor patients during water births, in whirlpool or submersion water baths, during showers, or in any other situation where the mother is immersed in water. Doing so may result in electrical shock hazard.

EXTERNAL VGA CONNECTIONS—Connect only to GE recommended display. ONLY remove cover plate if external display is used.

TELEMETRY CONNECTIONS—Connect only to GE recommended telemetry systems. Contact your GE service representative for more information.

WARNINGS

COLOR DISPLAY—Certain colors may have limited visibility at a distance. Color-blind individuals may experience this more often.

EXERGEN® TAT-5000™ —Cable assembly 2036641-001 cannot be field serviced. Do **NOT** attempt any repairs to this assembly. This assembly must be returned to the factory for any repairs. This assembly, as shipped, is important to patient safety.

DISPOSAL—This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or country laws. (Within this system, the backlight lamps in the monitor display contain mercury.)

Cautions

CAUTIONS

STATIC ELECTRICITY—This assembly is extremely static sensitive and should be handled using electrostatic discharge precautions.

ANNUAL SERVICING—For continued safety and performance of the monitor, it is recommended that the calibration, accuracy, and electrical safety of the monitor be verified on an annual basis by a GE Medical Systems *Information Technologies* Service Representative.

DAILY TESTING—It is essential that the monitor and accessories be inspected every day. It is recommended practice to initiate the monitor's self-test feature at the beginning of each monitoring session; follow the instructions in Chapter 4, "Setup Procedures".

ENVIRONMENT—The performance of the monitor has not been tested in certain areas, such as x-ray and imaging suites. The monitor is not recommended for use in these environments.

EQUIPMENT CONFIGURATION—The equipment or system should not be used adjacent to, or stacked with, other equipment. If adjacent or stacked use is necessary, the equipment or system should be tested to verify normal operation in the configuration in which it is being used.

PERFORMANCE—Report all problems experienced with the monitor. If the monitor is not working properly, contact your Service Representative for service. The monitor should not be used if it is not working properly.

Electromagnetic Interference

This device has been tested and found to comply with the Medical Electrical Equipment-General Requirements for Safety-Collateral Standard: Electromagnetic Compatibility, EN60601-1-2:2001, Medical Device Directive 93/42/EEC. These limits are designed to provide reasonable protection against harmful interference in a typical medical installation.

However, because of the proliferation of radio-frequency transmitting equipment and other sources of electrical noise in the health-care and home environments (e.g. cellular phones, mobile two-way radios, electrical appliances), it is possible that high levels of such interference due to proximity or strength of a source, may result in disruption of performance of this device.

Refer to the Electromagnetic Immunity information in this product's service manual for EN 60601-1-2 (2001) compliance information and safety information for this product.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may cause harmful interference with other devices in the vicinity. Disruption or interference may be evidenced by erratic readings, cessation of operation, or incorrect functioning. If this occurs, the use site should be surveyed to determine the source of this disruption, and actions should be taken to eliminate the source.

The user is encouraged to try to correct the interference by one or more of the following measures:

- Turn equipment in the vicinity off and on to isolate the offending equipment.
- Reorient or relocate the other receiving device.
- Increase the separation between the interfering equipment and this equipment.
- If assistance is required, contact your GE Medical Systems Service Representative.

Equipment Symbols

The following is a list of symbols used on products manufactured by GE Medical Systems *Information Technologies*. Some symbols may not appear on your unit.

Equipment Symbols	
	ATTENTION: Consult accompanying documents.
	WASTE OF ELECTRICAL AND ELECTRONIC EQUIPMENT (WEEE): This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.
	TYPE B EQUIPMENT: Type B equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application.
	TYPE BF EQUIPMENT: Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment has an F-type applied part.
	DEFIBRILLATOR-PROOF TYPE BF EQUIPMENT: Type BF equipment is suitable for intentional external and internal application to the patient, excluding direct cardiac application. Type BF equipment is type B equipment with an F-type isolated (floating) part. The paddles indicate the equipment is defibrillator proof.
	TYPE CF EQUIPMENT: Type CF equipment is suitable for intentional external and internal application to the patient, including direct cardiac application. Type CF equipment has an F-type applied part.

Equipment Symbols	
	DEFIBRILLATOR-PROOF TYPE CF EQUIPMENT: Type CF equipment is suitable for intentional external and internal application to the patient including direct cardiac application. Type CF equipment is F-type applied part that provides a higher degree of protection against electric shock than that provided by Type BF applied parts.
	ALTERNATING CURRENT (AC).
	EQUIPOTENTIALITY.
O	POWER OFF: disconnection from the mains.
I	POWER ON: connection to the mains.
	VGA connection.

2 Introduction

For your notes

About the Manual

Purpose

This manual documents all possible parameters so that when your equipment is upgraded, new documentation will not be required. Also, the manual provides an opportunity to read about features you may not have, to assist you with your upgrade decisions. Some sections will not apply to your unit's monitoring capabilities.

Intended Audience

This manual is intended for physicians, nurses and midwives. Clinical professionals are expected to know the medical procedures, practices, and terminology required to monitor obstetrical patients.

Illustrations

All illustrations are provided as examples only. Your monitor may not be equipped with the specific feature shown. In addition, unless explicitly stated, the display examples do not represent your equipment setup or displayed data.

Series Overview

The Corometrics 250cx Series monitor provides one solution for high-risk and low-risk labors and deliveries. The monitor lets you start with a fetal or maternal/fetal monitor and add the extended features later, as your clinical needs increase and your budget allows. The model of the monitor determines which parameters are in your monitor.

MODEL	Fetal Heart Rate (Twins) US	FECG	TOCO /IUP	NIBP	$MSpO_2$	MECG
256cx	✓	✓	✓			
259cx	✓	✓	✓	✓	✓	✓

The 250cx Series Monitor Features

The 250cx Series monitor offers the following features:

System Parameters (256cx and 259cx)

- The QVGA LCD display, with circularly polarized filter, removes glare; its wide viewing angle provides sharp viewing at a distance.
- The large display area provides simultaneous display of fetal parameters, maternal parameters, and maternal waveforms.
- The Brightness softkey permits clear viewing in all lighting conditions.
- Frequently used functions are controlled by your choice of front panel monitor buttons—Volume, UA Reference, Alarm Silence, Mark [Offset], Record, and Paper Advance.
- System setup options are easily accessed via a front panel Trim Knob control.
- Automatic mode selection is provided simply by inserting the appropriate transducer plug into the front panel receptacle.
- Transducer connectors are easy-to-use, color-coded, and durable.
- Annotations from an optional Model 2116B Keyboard are printed on the strip chart recorder paper.
- The strip chart recorder is a quiet, easy-to-load, high-resolution thermal array printer. The recorder prints continuous trends and alphanumeric data on one strip chart.
- The Chart Light allows the room lights to be dimmed without sacrificing visibility of the strip chart recorder.
- The system is compatible with Centricity® Perinatal Clinical Information Systems, as well as with other information systems, to streamline capture and archiving of patient data.

Following is a summary of the features.

Fetal Only Monitor (256cx)	Maternal/Fetal Monitor (259cx)
■ US	■ US
■ US2	■ US2
■ FECG	■ FECG
■ TOCO	■ TOCO
■ IUP	■ IUP
	■ NIBP
	■ $MSpO_2$
	■ MECG

Fetal Parameters

- Dual ultrasonic heart rate monitoring allows for non-invasive monitoring of twins.
- Independent volume controls facilitate easy transducer placement when monitoring twins.
- A +20 bpm heart rate offset option is provided for the secondary heart rate (HR2) trend, when using dual ultrasound, or ultrasound and direct FECG, to separate overlapping FHR trends for easy interpretation.
- A heartbeat coincidence detection feature can be enabled to inform you when there is the possibility that you may be monitoring a duplicate signal.
- The FECG waveform can be optionally displayed and can be “frozen” on the screen for review. In addition, a 6-second “snapshot” can be printed on the strip chart paper.
- Fetal parameters are continuously displayed even during configuration of system setup options.
- The ultrasound mode provides clean, accurate traces with few “dropouts” because of Corometrics’ patented autocorrelation processing.
- Fetal heart rate alarm limits are user-defined, with pre-set defaults. Signal quality has no user-defined parameters.
- Alarm limits are easily configured via setup screens.
- Alarm silencing is controlled by a brightly colored, easily recognizable front panel monitor button.
- Alarm conditions have both audible and visual indications. Only fetal audible alarms can be disabled. Fetal heart rate threshold and signal quality alarms can be cancelled.
- Optional Spectra Alerts™ simultaneously analyzes FHR and UA information and notifies clinicians of deviations from the norm.

Maternal Parameters (259cx only)

- Built-in maternal vital signs monitoring eliminates the need for separate blood pressure and maternal pulse oximetry monitors.
- Maternal vital signs storage provides an 8-hour history of the maternal vital signs in a spreadsheet format. The data can be displayed or printed on-demand.
- A maternal-only recording mode is specifically designed for postpartum monitoring of the mother.
- The monitor can be interfaced to the most widely used non-invasive blood pressure monitors and pulse oximeters.
- Maternal non-invasive blood pressure readings can be taken on-demand or at pre-programmed intervals. The use of unique, patented DINAMAP® SuperSTAT blood pressure technology provides blood pressure accuracy and faster, automated readings.
- Smart BP option prevents blood pressure readings from occurring during contractions.
- Continuous non-invasive $MSpO_2$ oxygen saturation and maternal pulse rate can be reliably monitored using well-known user-preferred pulse oximetry brands. Masimo SET, Nellcor OxiMax, or Ohmeda TruSignal $MSpO_2$ may be selected at the time of purchase or changed later as determined by hospital needs.

- The $MSpO_2$ pulsatile waveform can be optionally displayed and can be "frozen" on the screen for review. In addition, a 6-second "snapshot" can be printed on the strip chart paper.
- Continuous display/printing of the maternal pulse rate trend can be enabled.
- The MECG waveform can be optionally displayed and can be "frozen" on the screen for review. In addition, a 6-second snapshot can be printed on the strip chart paper.
- Built-in independent MECG monitoring is provided with selection of lead I, II, or III.
- Selectable 3-lead maternal ECG with pacemaker detection and rejection generates maternal heart rate, QRS waveform display and a 6-second snapshot printout when requested.
- Twins *and* maternal monitoring can be accomplished simultaneously using dual ultrasound *and* MECG, or by using ultrasound, FECG, *and* MECG.
- Maternal alarm limits are user-defined, with preset defaults; they are easily configured via setup screens.
- Maternal alarm conditions have audible and visual indications, and can be silenced for a user-specified time.
- Alarm silencing is controlled by a brightly colored, easily recognizable front panel monitor button.

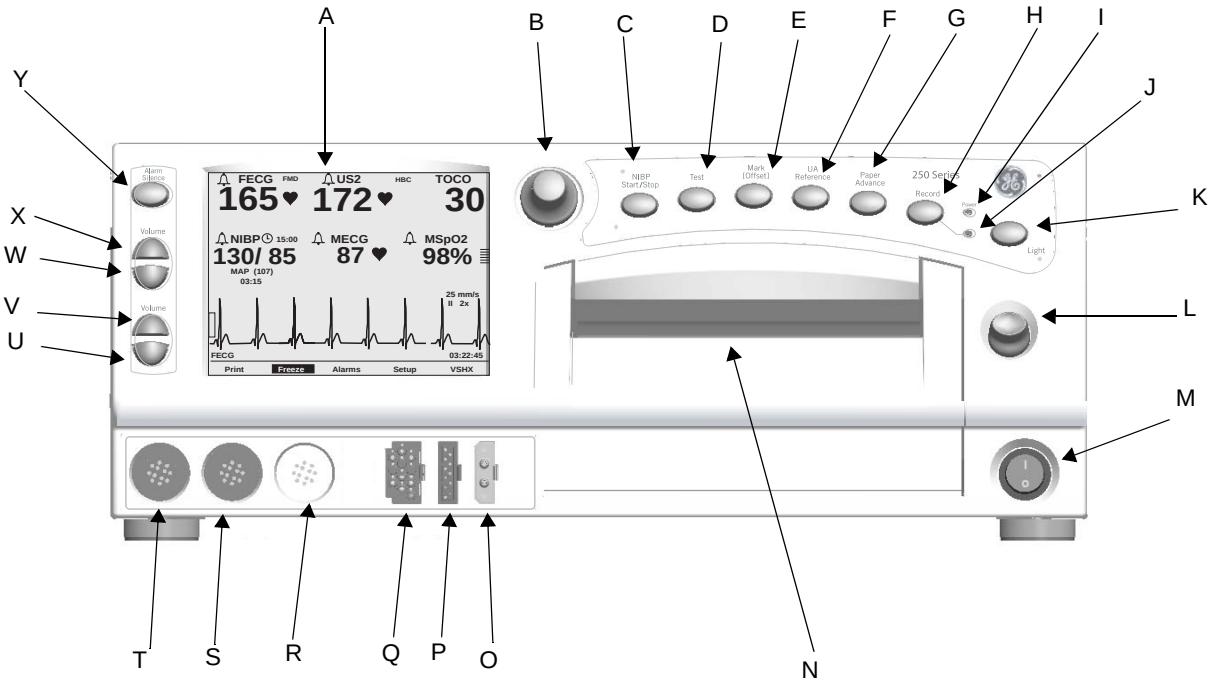
Adding Fetal Movement Detection and/or Spectra Alerts

The monitor can be upgraded to include Fetal Movement Detection and/or Spectra Alerts. Contact your local sales representative for upgrade information.

3 Controls, Indicators, and Connectors

For your notes

Front Panel Description



Monitor Front Panel

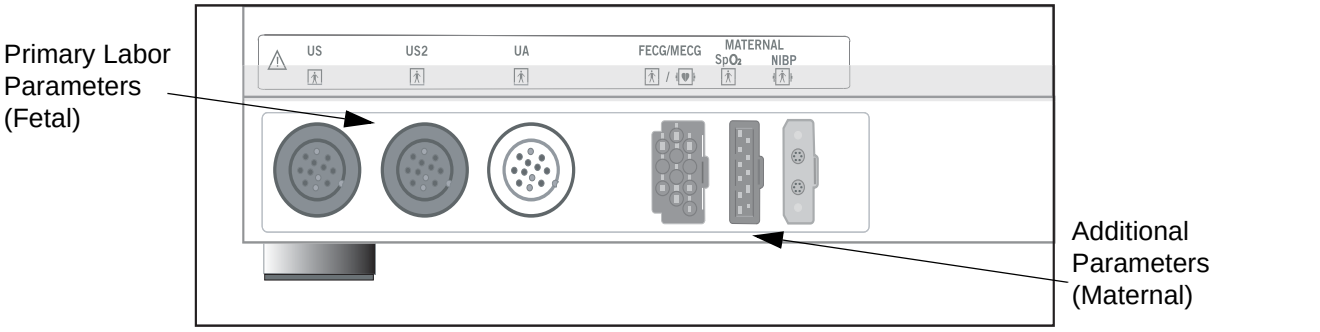
Front Panel		
#	Name	Description
A	Display	The monitor's display is divided into several sections. The content and layout of the display can change, depending on which functions are installed in the monitor and the modes of operation in use.
B	Trim Knob Control	Operation of the monitor is controlled by using the front panel buttons in conjunction with the Trim Knob control. This control selects softkeys on the display and positions a cursor within a setup screen. Rotate the Trim Knob control left or right to highlight items on the screen with a bar cursor. After highlighting the desired item, press the Trim Knob control to make the selection. In summary: rotate to move cursor; press to select an item.
C	NIBP **Start/Stop** Button	This button starts and stops both manual and automatic blood pressure determinations. It also provides a "shortcut" for changing the auto interval time (see 8-12).
D	**Test** Button	Pressing and holding this button for 1 second starts or stops a monitor self-test routine.

Front Panel		
#	Name	Description
E	Mark [Offset] Button	The Mark [Offset] button is a multi-function button. ■ Mark: Pressing this button prints an event mark ↑ on strip chart paper (on the bottom two lines of the top grid). ■ Offset: When the Heart Rate Offset mode is enabled, pressing and *holding* this button shifts the secondary FHR trend +20 bpm for visibility purposes. Refer to "Fetal Heart Rate Offset" on page 5-11.
F	UA Reference Button	The UA Reference button sets a baseline for uterine activity pressure monitoring. Refer to Chapter 6, "Uterine Activity Monitoring".
G	Paper Advance Button	Pressing this button advances chart paper at a rate of 40 cm/min for as long as the button is held down.
H	Record Button	The Record button selects one of three recorder states: on, maternal-only mode, or off. Refer to Chapter 11, "Recorder Modes". Factory default is OFF.
I	Power Indicator	The indicator lights green when the monitor is turned on.
J	Record Indicator	Indicator Status / Recorder Status on / on off / off three short flashes every 5 sec / maternal-only mode flashes on and off / error condition
K	Light Button	Illuminates the strip chart paper for night time visibility. Factory default is ON.
L	Recorder Door Latch	Opens the strip chart recorder door to add, remove, or adjust the paper.
M	Power Switch	Moving the switch to the *on* position (I) turns the monitor on; moving the switch to the *off* position (O) turns the monitor off.
N	Strip Chart Recorder	Annotations and trends are printed on the strip chart paper. Two paper styles are available. Refer to Chapter 4, "Setup Procedures", for instructions on loading strip chart paper into the recorder. Refer to Chapter 11, "Recorder Modes" for additional information about trends and annotations.
O	MATERNAL NIBP Connector	Connect a pneumatic hose and blood pressure cuff assembly to this black twin lumen receptacle.
P	MATERNAL SpO_2 Connector	Connect a 250cx Series $MSpO_2$ intermediate cable to this royal blue receptacle. Use only Nellcor Maternal Oxygen Saturation Sensors if Nellcor technology is installed in your monitor, Masimo Sensors if Masimo technology is installed in your monitor, or Ohmeda Sensors if Ohmeda technology is installed in the monitor.
Q	FECG/MECG Connector	Connect an FECG cable/legplate or MECG cable plug to the FECG/MECG receptacle. Cables with *rectangular* plugs connect directly to the FECG/MECG receptacle. Cables with *round* plugs require an FECG/MECG adapter. Refer to "MECG Ordering Information" on page 18-5 for the adapter part number. This adapter is used for dual ECG monitoring as well. The adapter branches into two cables, each with a *round* receptacle at the end: one branch is labeled MECG; the other branch is labeled FECG.

Front Panel		
#	Name	Description
R	UA Connector	Connect a tocotransducer, IUPC, or strain gauge transducer plug to this white receptacle. Contact your Sales Representative for information about compatibility.
S	US2 Connector	Connect the secondary ultrasound transducer plug to this light gray receptacle.
T	US Connector	Connect the primary ultrasound transducer plug to this light gray receptacle.
U	FHR2 **Volume** Decrease Button	The four **Volume** buttons raise (△) and lower (▽) the volume of sound emitted by the rear panel speaker. The upper pair controls the volume for FHR1. The lower pair controls the volume for FHR2. Volume settings have no effect on the processing used to determine heart rate. The **Volume** buttons work in conjunction with the volume control settings on the *US/US2 Setup* screen (page 5-3) and on the *FECG Setup* screen (page 5-5).
V	FHR2 **Volume** Increase Button	
W	FHR1 **Volume** Decrease Button	
X	FHR1 **Volume** Increase Button	
Y	**Alarm Silence** Button	Pressing this button removes the audible indication of an individual alarm. (Refer to Re-Alarm in the “Alarms” Section for more information.)

Front Panel Displays

The monitor is divided into two main sections: patient information (the left-side of the monitor) and monitor functionality (the right-side of the monitor). Refer to “Monitor Front Panel” on page 3-3. The keys are ordered for user efficiency.The content and layout of the display can change, depending on which functions are installed in the monitor and the modes of operation in use.



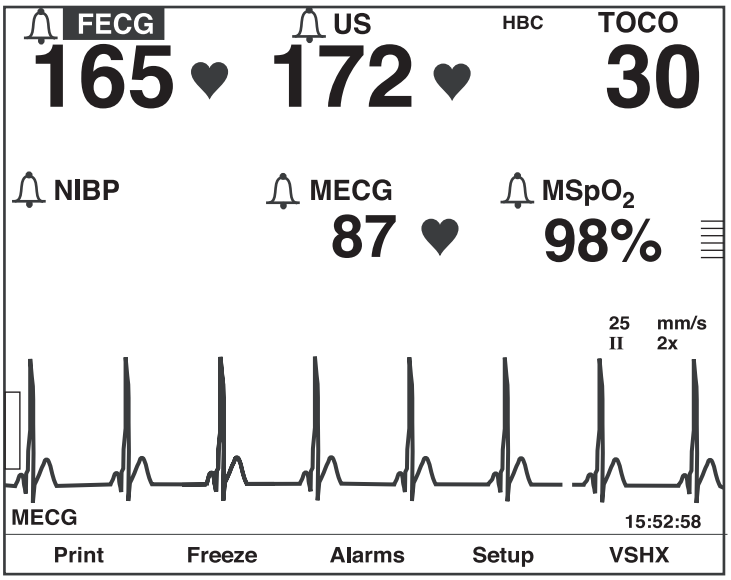
Maternal and Fetal Parameters

Display Summary		
Display Section	**Item**	**Mode**
Primary Labor Parameters (upper portion of monitor)	Fetal Heart Rate 1 (FHR1)	*US*, *US2*, *FECG*, or *INOP*
	Fetal Heart Rate 2 (FHR2)	*US*, *US2*, or *INOP*
	Uterine Activity (UA)	*TOCO*, *IUP*, or *INOP*
Additional Parameters (Available in Maternal/Fetal Monitor only)	Maternal Blood Pressure	*NIBP*
	Maternal Heart/Pulse Rate	*MECG*, *Pulse* or *INOP*
	Maternal SpO_2	*MSpO*$_2$
Waveform	Fetal ECG Waveform, Maternal ECG Waveform, or Maternal SpO_2 Pulsatile Waveform	*FECG*, *MECG*, *MSpO*$_2$, or *Off*
Time	Current Time, [Label] *Frozen* Message and Time of Activation	—
Softkeys	System Configuration Softkey Controls	—

Display Example

From the graphic below, you can determine the following:

- Blood pressure is not active as indicated by the absence of numerics.
- Maternal pulse oximetry is active by presence of pulse amplitude indicator.
- *MECG* is selected as the heart rates source as indicated by the *MECG* mode title softkey—rather than *Pulse*.
- The MECG waveform is displayed at *25 mm/sec*, at a size of *2x*, with lead *II* selected.
- Heartbeat coincidence is enabled as indicated by the *HBC* acronym in the primary labor parameters area.
- All alarms are enabled as indicated by 🔔.



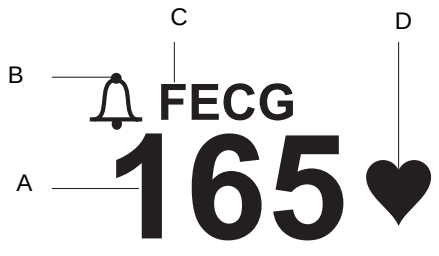
Maternal/Fetal Monitor Display Example

Primary Labor Parameters

The primary labor parameters section displays FHR1, FHR2, and UA data.

FHR Display

The FHR1 and FHR 2 areas are summarized in the following figure and table.



FHR Display

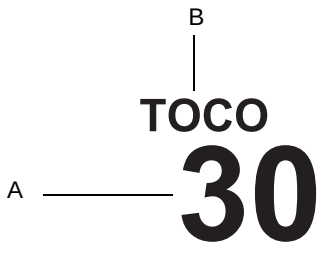
FHR Display		
	Name	Description
A	FHR Value	Up to three digits indicate the fetal heart rate in beats per minute.
B	FHR Alarm Setting Indicator	This symbol provides information about the FHR audio alarm ***and*** the FHR high/low alarm limit settings. See Chapter 10, "Alarms" for more information. ■ : All alarm settings are enabled. ■ At least one fetal alarm is disabled.
C	FHR Mode Title	An abbreviation indicates the monitoring mode in use: *FECG*, *US*, *US2*, or *INOP*. (*FECG* only displays in the FHR1 area.) Select the mode softkey to access the respective setup screen. See "Connectors vs. Display Modes" Table below for FHR connection options.
D	FHR Heartbeat Indicator	Flashes with each detected valid heartbeat.

Connectors vs. Display Modes		
Active Connectors	FHR1 Area	FHR2 Area
FECG	*FECG*	*INOP*
FECG/US	*FECG*	*US*
FECG/US2	*FECG*	*US2*
US	*US*	*INOP*
US/US2	*US*	*US2*
US2	*US2*	*INOP*
—	*INOP*	*INOP*
FECG/US/US2[1]	*FECG*	*US2*

[1] If three FHR transducers are plugged in, the FECG signal overrides the US signal.

UA Display

The *UA* area is summarized by the following figure and table.



UA Display

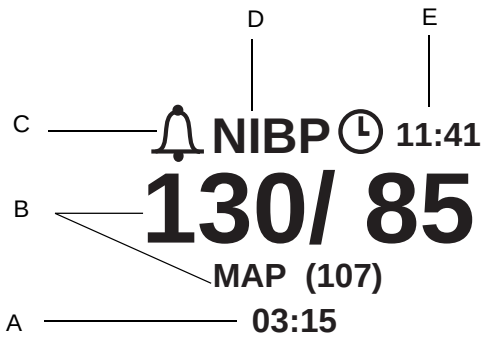
UA Display		
	Name	Description
A	UA Value	Up to three digits indicate the uterine activity value—mmHg or kPa. Internal UA monitoring is absolute and external monitoring (Toco) is relative. The units are consistent in both cases and are user-selectable: mmHg or kPa.
B	UA Mode Title	An abbreviation indicates the monitoring mode in use: *TOCO*, *IUP*, or *INOP*.

Additional Parameters

The additional parameters area displays NIBP, MHR/P, and $MSpO_2$ data.

Maternal NIBP

The maternal NIBP section is summarized in the following figure and table.

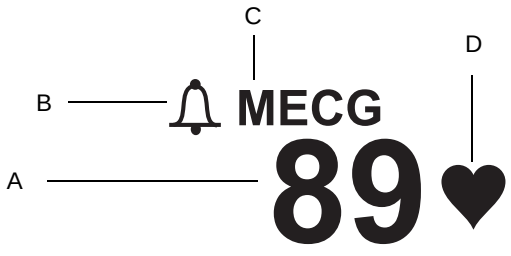


NIBP Display

NIBP Display		
	Name	Description
A	NIBP Time Stamp	The time (in 24-hour format) of the last blood pressure measurement.
B	NIBP Values	The systolic/diastolic and mean arterial pressures (MAP) are each indicated by up to three digits—displayed as XXX mmHg or XX.X kPa. All kPa readings are displayed to 1/10 kPa. During a determination, the instantaneous cuff pressure displays in place of the mean arterial pressure and is denoted by the title *Cuff*.
C	NIBP Alarm Setting Indicator	This symbol provides information about the NIBP audio alarm ***and*** the NIBP high/low alarm limit settings. See Chapter 10, "Alarms" for more information. Maternal alarms cannot be disabled.
D	NIBP Mode Title	Select the mode title to access the *NIBP Setup* screen.
E	NIBP Countdown Timer	The clock symbol represents activation of the auto mode. The countdown timer indicates the minutes and seconds until the next automatic reading.

MHR/P Area

The MHR/P area is summarized by the following figure and table.

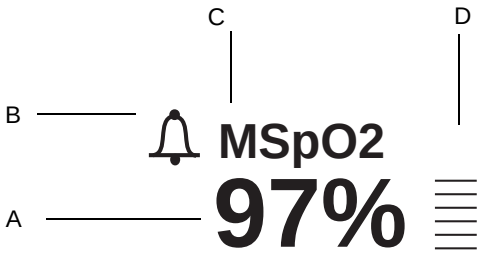


MHR/P Display

MHR/P Display		
	Name	Description
A	MHR/P Value	Up to three-digits indicate the MHR/P in beats per minute.
B	MHR/P Alarm Setting Indicator	This symbol provides information about the MHR/P audio alarm ***and*** the MHR/P high/low alarm limit settings. See Chapter 10, "Alarms" for more information. Maternal alarms cannot be disabled.
C	MHR/P Mode Title	The mode title *MECG* indicates MECG is the MHR/P source; the mode title *Pulse* indicates $MSpO_2$ or NIBP is used as the source. Select the mode title softkey to access the *MHR/P Setup* screen.
D	Maternal Heartbeat Indicator	Flashes with each detected valid heartbeat—for MECG only.

$MSpO_2$ Area

The *$MSpO_2$* area is summarized in the following figure and table.



$MSpO_2$ Display

$MSpO_2$ Display		
	Name	Description
A	$MSpO_2$ Value	Up to three digits indicate the percentage of oxygen in the mother's blood.
B	$MSpO_2$ Alarm Setting Indicator	This symbol provides information about the $MSpO_2$ audio alarm ***and*** the $MSpO_2$ high/low alarm limit settings. See Chapter 10, "Alarms" for more information. Maternal alarms cannot be disabled.
C	$MSpO_2$ Mode Title	Select the mode title to access the *$MSpO_2$ Setup* screen.
D	$MSpO_2$ Pulse Amplitude Indicator	This vertical bar qualitatively indicates pulse amplitude.

Waveform Area

The waveform area displays approximately 4 seconds of waveform data for: FECG, MECG, or $MSpO_2$. Refer to Chapter 14, "Waveforms" for more information.

Time and Waveform Message Area

The current time (in 24-hour format) always displays on the far right. When a waveform is frozen, the message *Frozen* displays on the far left, bottom corner, along with the time of activation.

Battery-Backed RAM Status

Whenever you turn off a 250cx Series Monitor, a battery provides power to the RAM (random access memory) that stores information such as time, date, default settings, etc.

Low Battery Icon

The icon shown above will appear in the upper right-hand section of the monitor under the following circumstances.

Battery-Backed RAM Status		
Icon Appearance	Reason	Solution
Icon appears and then disappears after power cycle.	Data corruption. Your monitor has reverted to factory settings.	Access setup screens and configure last-used settings.
Icon appears after multiple power cycles.	Battery requires service.	Call GE Service to report.
SET TIME/DATE message prints on the strip chart paper.	Failure of the battery-backed RAM to retain time and date.	Reset the time and date then power cycle the monitor. If message still prints, call GE Service to report.

Softkeys

A softkey is an area on the screen that can be selected with the Trim Knob control. When the softkey is activated by pressing the Trim Knob control, it may cycle through available settings or it may display a setup screen.

Mode Title Softkeys

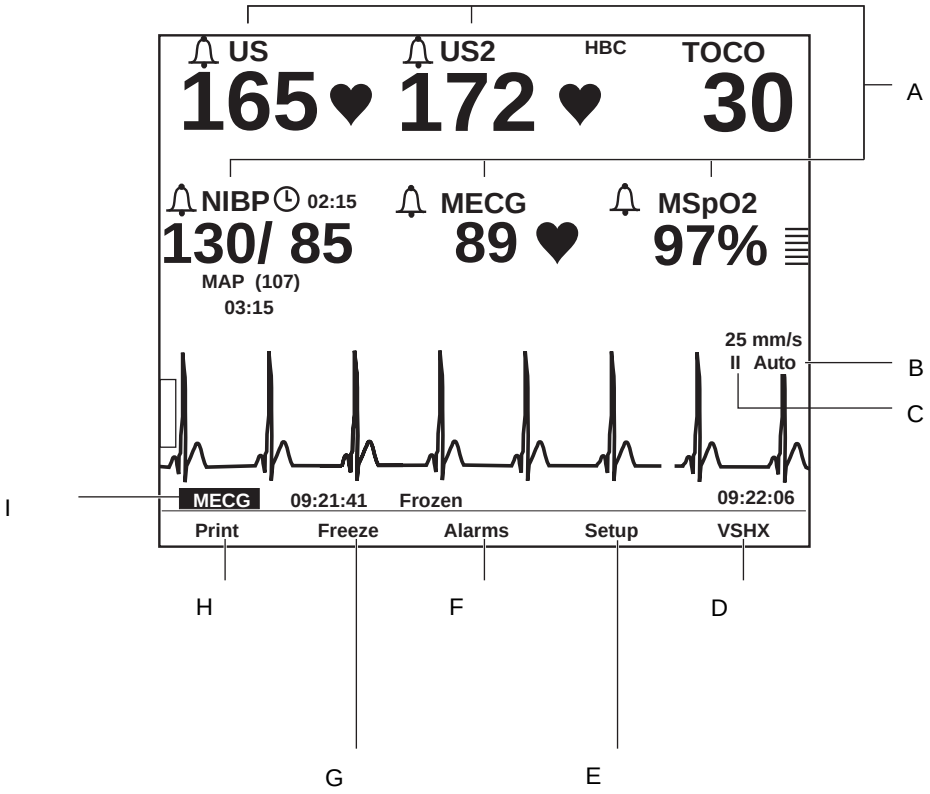
Most of the mode titles in the display are also softkeys which give access to corresponding setup screens: *US*, *US2*, *FECG*, *NIBP*, *MECG*, *Pulse*, and *MSpO*$_2$.

Waveform Softkeys

The waveform title is a softkey used to select the waveform for display or to disable the area. The ECG *Scaling* and *MECG lead* labels are softkeys used to configure the waveform currently displayed.

Dedicated Softkey Area

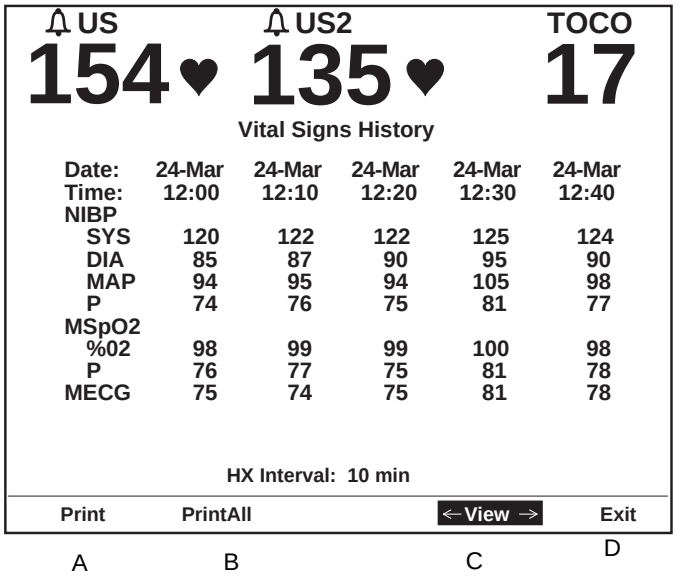
Softkeys are located at the bottom of each screen, as shown in "Maternal/Fetal Monitor Display Summary" on page 3-14. Although there are many possible softkeys which may appear in this area, a maximum of five are shown at a time.



Maternal/Fetal Monitor Display Summary

Display Summary		
	Name	Description
A	Mode Title Softkeys	Selects *US*, *US2*, *FECG*, *NIBP*, *MHR/P*, or *SpO_2 Setup* screens.
B	ECG Scale Softkey	Selects *0.25x*, *0.5x*, *1x*, *2x*, *4x*, or *Auto*.
C	*MECG Lead* Select Softkey	Selects Lead *I*, *II*, or *III*.
D	*VSHX* Softkey	Displays maternal *Vital Signs History* screen. (See illustration below.)
E	*Setup* Softkey	Displays *General Setup* screen
F	*Alarms* Softkey	Displays *Master Alarm Setup* screen.

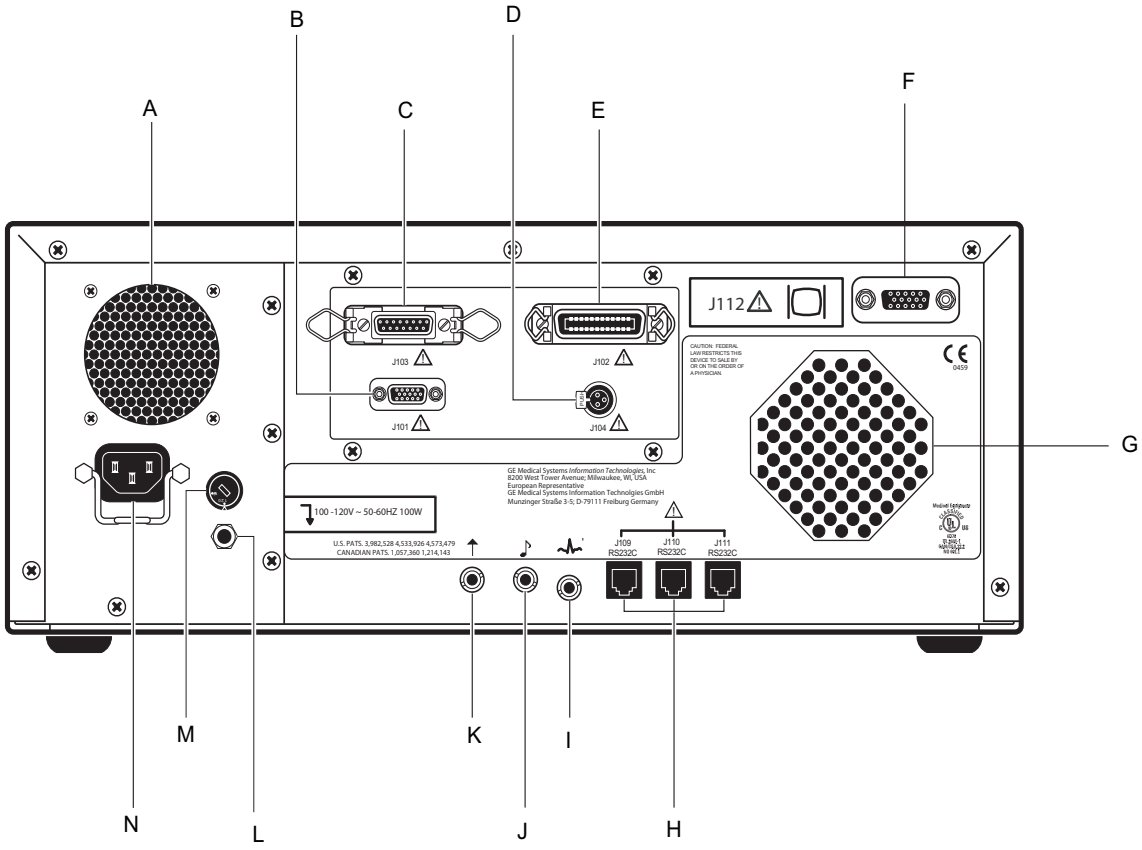
Display Summary		
	Name	Description
G	*Freeze* Softkey	Freezes waveform for analysis; unfreezes waveform to return to real-time display.
H	*Print* Softkey	Prints 6-second snapshot of frozen waveform, real-time waveform, or maternal vital signs history.
I	Waveform Softkey	Selects *FECG, MECG, MSpO$_2$,* or *Off*.



I Maternal Vital Signs History Screen Softkeys

Maternal Vital Signs History Screen Softkeys		
	Name	Description
A	*Print* Softkey	Prints one page (screen) of the table.
B	*PrintAll* Softkey	Prints all pages (screens).
C	*View* Softkey	Scrolls through the data: ■ Counterclockwise for newest data ■ Clockwise for oldest data
D	*Exit* Softkey	Returns to the previous screen.

Rear Panel Description



Monitor Rear Panel Connectors (Standard and Optional)

IMPORTANT: The Fetal Acoustic Stimulator and Remote Event Marker connectors are identical in size and shape. Be sure you connect to the proper connector to ensure accurate information.

250cx Series Rear Panel (Standard and Optional Features)		
	Name	Description
A	Vent	Provides ventilation for the monitor's internal circuitry.
B	J101 Telemetry Connector	Connector for Corometrics telemetry system interface.
C	J103 Data Entry Connector	Connector for data entry system interface.
D	J104 Nurse Call Connector	Connector for standard Nurse Call System interface. The connector's maximum output is 50 Vdc at 100 mA; the maximum on resistance is 0.5 Ω.

250cx Series Rear Panel (Standard and Optional Features)		
	Name	Description
E	J102 Central Systems Connector	Connector for analog central station system interface.
F	J112 External VGA Connector	Connector for external VGA display. Use of recommended GE external display will allow monitor front panel display video to be replicated remotely.
G	Speaker	The rear panel speaker emits an audible tone for heart rates, $MSpO_2$ pulse with $\%O_2$-dependent pitch, and alarms. It also provides the sound for the song player feature.
H	J109, J110, and J111 RS-232C Communications Connectors	Three serial RJ-11 connectors are provided for interfacing to peripheral equipment. Contact your GE Service Representative for more information.
I	ECG Out Connector	External recorder receptacle for MECG signals. The standard output level is 1 V/mV.
J	Fetal Acoustic Stimulator Connector	Receptacle for Corometrics Model 146 Fetal Acoustic Stimulator (FAST). A musical note symbol prints on the strip chart paper each time the Model 146 is used: ♪
K	Remote Event Marker Connector	Receptacle for the Corometrics Remote Event Marker. When activated, one of the following marks prints on the strip chart paper: ■ The event marker is commonly used to record an "event": ↑ ■ The fetal movement marker (default setting) is commonly used as an indication that the mother has perceived fetal movement: FM ↑ Refer to the "Coro 250/250cx Series Monitor Service Manual" for more information.
L	Equipotential Lug	A binding post terminal is directly connected to the chassis for use as an equipotentiality connection.

250cx Series Rear Panel (Standard and Optional Features)		
	Name	Description
M	AC Voltage Selection Switch	This switch is intended for qualified service personnel to select a voltage range for the AC input: ■ 120: Accepts an AC input in the range of 100–120 VAC. ■ 240: Accepts an AC input in the range of 220–240 VAC
N	Power Entry Module	AC line power cord receptacle. Refer to the rear panel markings to verify line voltage and line frequency requirements.

CAUTION

NON-DESTRUCTIVE VOLTAGE—The maximum non-destructive voltage that may be applied to the rear panel connectors is 0 volts. Do not attempt to connect cables to these connectors without contacting your Biomedical Engineering Department or GE Medical Systems *Information Technologies* Service Representative. This is to ensure the connectors comply with leakage-current requirements of one of the following applicable standards: Underwriters Laboratories UL-2601-1, Canadian Standards Associations CSA 22.2 No. 125, or International Electrotechnical Commission EN60601-1.

4 Setup Procedures

For your notes

Loading Strip Chart Recorder Paper

Refer to “Paper Supplies Ordering Information” on page 18-3 to order paper ***required*** for use with the 250cx Series Monitor.

- (HR scale of 30–240 bpm); or
- (HR scale of 50–210 bpm).

Refer to Chapter 11, “Recorder Modes” for more information about the different paper styles.

CAUTIONS

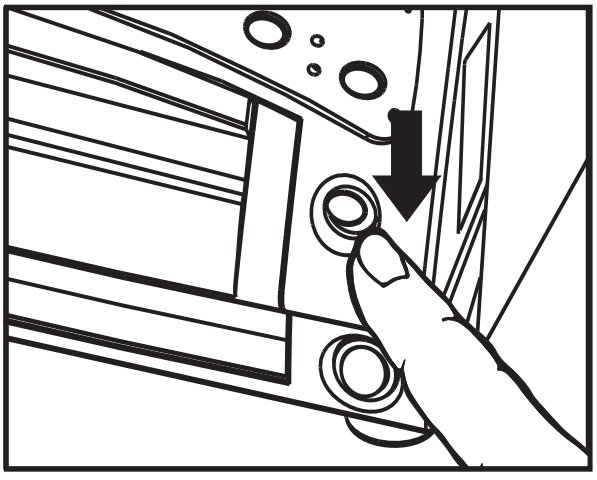
LOADING PAPER—The instructions for loading paper into the 250cx Series Monitor are different than the instructions for loading paper into other Corometrics monitors. Improper loading can cause paper jams. Follow the instructions carefully.

PAPER TYPE—Do not use *non*-Corometrics paper or paper designed for use with *other* Corometrics monitors. Using incorrect paper may produce inferior print quality, could result in permanent damage to the recorder’s print head, and may void your warranty. Refer to “Paper Supplies Ordering Information” on page 18-3 for the correct monitor paper part number.

STORAGE/TRANSPORT—Paper should be installed in the monitor’s strip chart recorder at *all* times. This reduces particle build-up on the printhead and facilitates opening the recorder door.

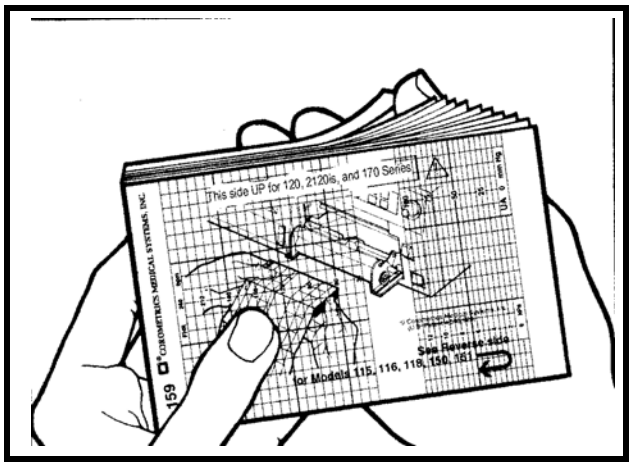
To install Corometrics chart paper in the 250cx Series Monitor, follow these steps:

1. Press down on the latch on the right side of the strip chart recorder door to open the recorder door.



Opening the Recorder Door

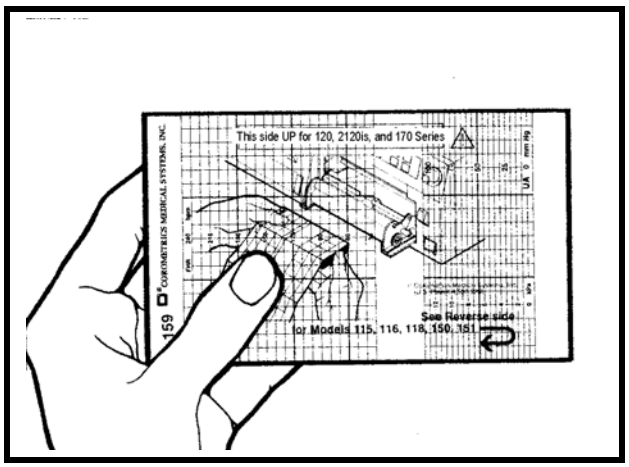
2. Fan the pack of Z-fold paper on all sides to loosen any folds and to ensure proper feed of the paper through the recorder.



Fanning the Paper

NOTE: The black squares indicate the end of the recorder paper. When the black squares appear, the strip chart recorder has approximately 20 minutes of paper remaining, when running at a speed of 3 cm/min.

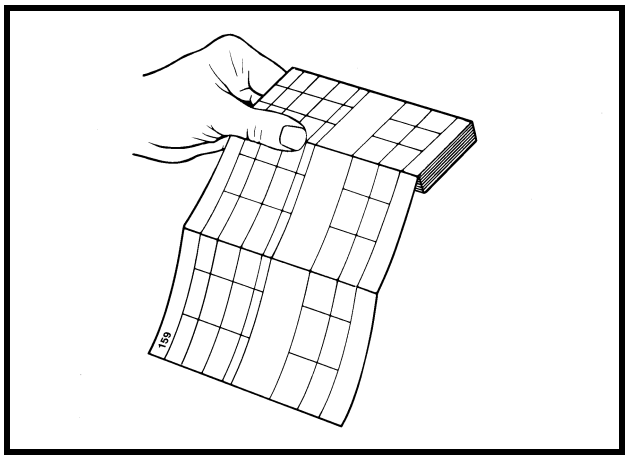
3. Hold the package of paper so that:
   - **the black squares are on the *bottom* of the pack**; and
   - the Corometrics logo and page numbers are on the *left* side of the pack.



Orienting the Paper

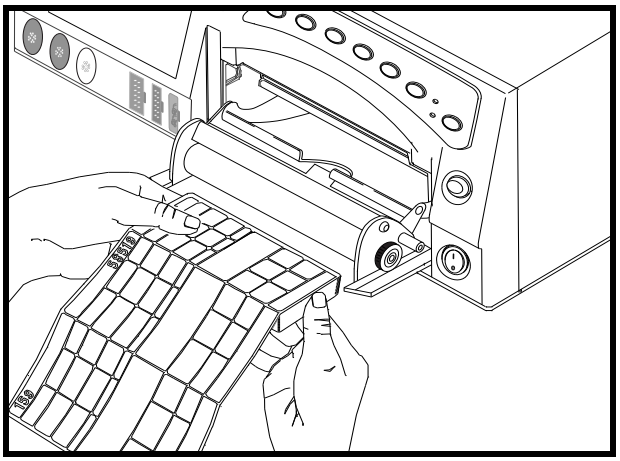
NOTE: The paper is labeled, “This side up for the 120, 2120is, and 170 Series.” This paper is compatible with and required for the 250cx Series.

4. Unfold two sheets from the *top* of the package so that they extend toward you.



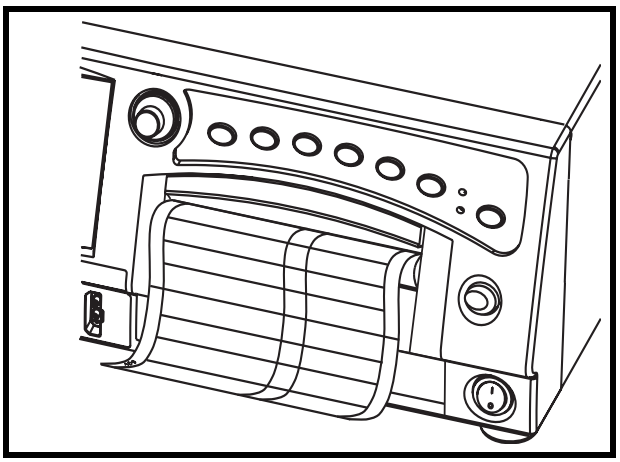
Creating Paper Leader

5. Place the pack in the drawer so that the pack is laying flat in the recorder.



Inserting the Paper

6. Close the strip chart recorder door.

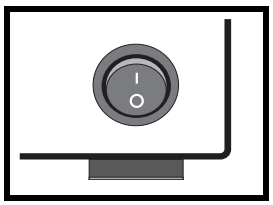


Closing the Recorder Door

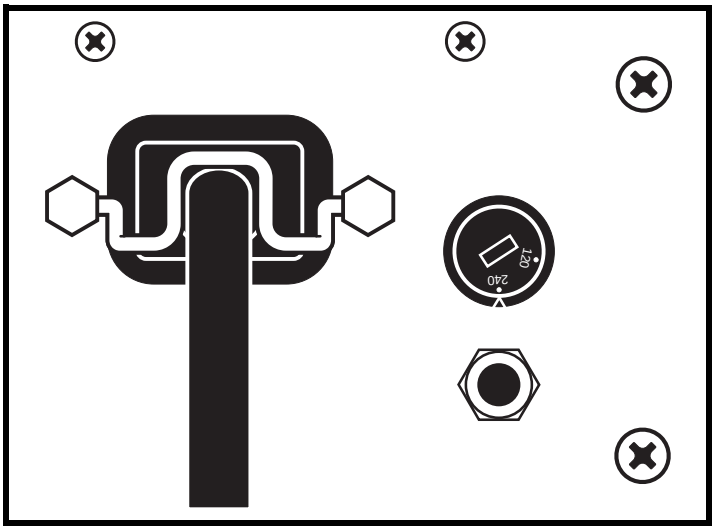
Refer to Chapter 11, “Recorder Modes” for information about paper-loading errors.

Power

1. Turn the monitor’s power off. The Power button is located in the lower right-hand corner of the monitor.



2. Connect the detachable line cord to the rear panel power connector; plug the other end into a hospital grade grounded wall outlet of appropriate voltage. (If you are unsure about the voltage, contact your hospital Biomedical Engineering Department or GE Service Representative.)



Attaching the Power Cord

3. Turn the monitor’s power on. The green indicator light, located near the upper left-hand corner of the Light button, illuminates and a series of tones are heard, indicating that the monitor has been turned *on*.

Interruption of Power

When the supply main to the monitor is interrupted for more than 30 seconds, the following behaviors occur.

- Configuration Settings: The configuration settings are restored to the current user-selected default setting: Factory or Hospital.
- Patient Data: The stored patient data—including vital signs history—are erased.
- NIBP: The NIBP parameter reverts to Manual Mode.

Self-Test Routine

The 250cx Series Monitor contains a self-test routine which checks the calibration and internal circuitry of the monitor. Initiate the self-test routine at the beginning of each monitoring session to print the results on the patient's strip chart.

NOTE: To stop a self-test routine that is in progress, press the Test button or open the recorder door.

1. Ensure that strip chart is loaded.
2. Press the Test button.
3. Refer to the table below and ensure the test results are produced as expected. At the successful completion of the self-test routine, the monitor is ready for use.

Monitor Self-Test Routines	
Test Routine	Description
Display Test	All display pixels extinguish for one second and then illuminate for one second. A green horizontal line moves down on a red background followed by a blue vertical line moving from left to right.
Lamp Test	The yellow Record indicator illuminates.
Recorder Test	The message *TEST: ARE ALL DOTS PRINTED?* prints followed by two vertical lines and four horizontal lines. The two vertical lines should appear continuous and indicate a fully functional printhead. The four horizontal lines align with the heart rate and uterine activity scales, i.e., 30 and 240 BPM or 50 and 210 BPM, and 0 and 100 mmHg (0.0 and 13.3 kPa).
Counting Test	After the recorder test, the display returns to the main screen. The software generates a 120 bpm rate in the FHR1 area, a 180 bpm rate in the *FHR2* area, and both mode titles display *Test.*
Uterine Activity	The monitor sets UA value to 50 mmHg and displays in the UA display area; the mode title displays *Test.*

Setup Screens

The 250cx Series Monitor provides a variety of options that are selected using the setup screens shown on the display. (The illustrations in this section are representative of all possible features. Your monitor screens may vary.) All functions are performed easily using the front panel Trim Knob control. Setup screens for *FECG, US/US2,* Maternal *NIBP, MHR/P,* and *MSpO$_2$* are detailed in Chapter 5.

Using the Trim Knob Control

General instructions for using the Trim Knob control follow:

NOTE: When any setup screen (except the *General Setup* screen) is displayed, the primary labor parameters remain displayed.

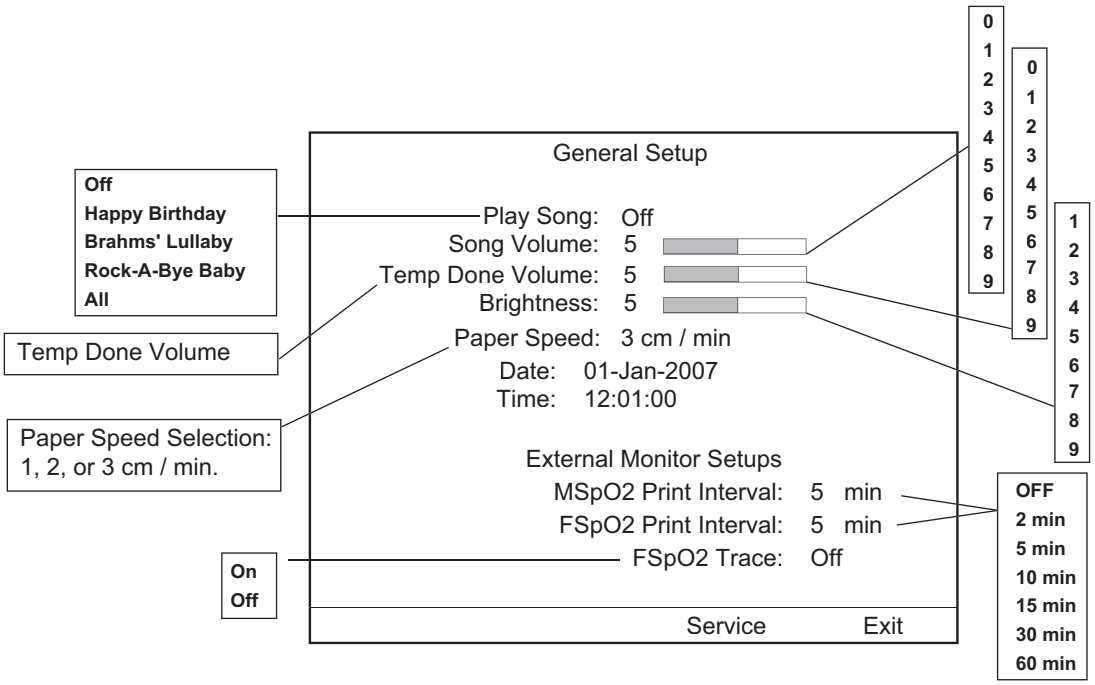
1. To display a parameter setup screen, rotate the Trim Knob control until the bar cursor highlights the title of the parameter *(FECG, US, US2, NIBP, MECG, Pulse, or $MSpO_2$).* To access the *Master Alarm Setup* screen or the *General Setup* screen, rotate the Trim Knob control until the bar cursor highlights the *Alarms* softkey or the *Setup* softkey, respectively, on the bottom of the screen.
2. Press the Trim Knob control once to display the selected setup screen.
3. While the screen is displayed, rotate the Trim Knob control until the desired field is highlighted.
4. Press the Trim Knob control again to activate the selected field. The cursor flashes to indicate the field is active.
5. Rotate the Trim Knob control in either direction to cycle through the available choices for the field.
6. When the desired selection is made for the field, press the Trim Knob control once to confirm the selection.
7. Repeat Steps 3 through 6 until all desired settings have been made.
8. Rotate the Trim Knob control until the bar cursor highlights the *Exit* softkey on the bottom of the screen. This returns the monitor to normal operation.

IMPORTANT

EFFECTIVITY—All changes take effect immediately after a selection is enacted in Step 6. Some changes take effect as the values are changed without having to press the Trim Knob.

General Setup Screen

Following is a sample *General Setup* screen.You can access this screen from the main screen by selecting *Setup*. Using the Trim Knob to go to the field you wish to change. and select it by pressing the knob. Choose the desired setting.



General Setup Screen

Play Song

You can activate a song to be played from the monitor's speaker to celebrate each birth.

Song Volume

This field sets the volume of the song player.

Temp Done Volume

This field adjusts the temperature completion volume. This field is only available when the Exergen protocol is configured.

Brightness

This field allows you to adjust the brightness of the backlight of the display. The settings range from *1* to *9* with *9* being the brightest setting.

Paper Speed

The monitor offers a choice of paper speeds of the strip chart recorder.

- *1 cm/min:* paper saving.
- *2 cm/min:* a compromise between the 1 cm/min and 3 cm/min.
- *3 cm/min:* recommended for greater diagnostic capability.

Date

It is very important to set the date on your monitor prior to initial use. The month field has a range from *01–12*; the range for the day field varies according to the selection for month and year[1]; the year field has a range of *00–99.* A long-lasting battery maintains the date even when the monitor is unplugged from AC power.

Time

It is also very important to set the monitor's clock prior to initial operation and during daylight-saving time changes. A long-lasting battery maintains the set time even when the monitor is unplugged from AC power.

The time is represented by a 24-hour clock in hours, minutes, and seconds. The hour field has a range of *00–23*; the minutes field has a range of *00–59*; the seconds field resets when minutes change.

$MSpO_2$ Print Interval

This field sets the time interval for printing $MSpO_2$ values received from an ***external*** maternal pulse oximetry monitor.

$FSpO_2$ Print Interval

This field sets the time interval for printing $FSpO_2$ values received from an ***external*** fetal pulse oximetry monitor.

$FSpO_2$ Trace

This field enables/disables $FSpO_2$ trend trace printing of data received from an ***external*** fetal pulse oximetry monitor.

Service

By choosing this option, you can view software revisions, what type of SpO_2 technology your 250cx Monitor contains (i.e., Ohmeda, Nellcor, and Masimo etc.), and allows service personnel to enter the password-protected Service Mode.

[1] For example, February of 1996 has a day range of 01-29; February of 1997 has a range of 01-28; August of 1997 has a day range of 01-31.

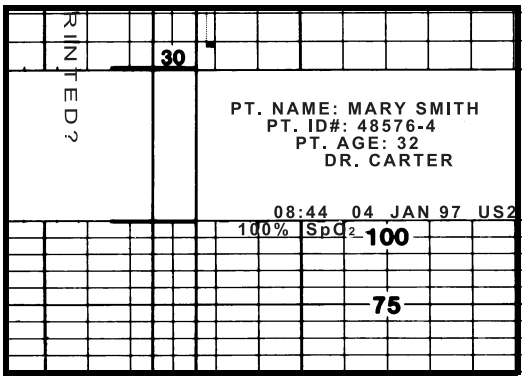
Preparing the Monitor for Patient Use

The following procedures should be performed before use on *each* patient:

1. Ensure an adequate supply of paper is in the recorder. The recorder will automatically stop when paper runs out. If the recorder requires paper, refer to “Loading Strip Chart Recorder Paper” on page 4-3.
2. Ensure the monitor power is on.
3. Connect the appropriate transducers for monitoring. Read the “Maternal/Fetal Monitoring, Clinical Applications Manual” for instructions on applying the transducers.
4. Ensure the setup menus are configured appropriately for use on this patient. Refer to “Setup Screens” on page 4-7.
5. Turn the recorder *on*. Refer to Chapter 11, “Recorder Modes” for more information.

> **CAUTION**
> PAPER MOVEMENT—Always ensure that the chart paper is moving properly from the front of the recorder drawer when the Record indicator light is on.

6. Press the Paper Advance button to create a paper leader.
7. Press the Test button to run the monitor’s self-test routines. Refer to “Self-Test Routine” on page 4-7.
8. Check the time and date printed on the strip chart paper. Refer to “General Setup Screen” on page 4-9 if you need to change the time/date setting.
9. Annotate the patient name and ID# using the optional Corometrics Model 2116B Data-Entry/Clinical-Notes Keyboard, if available.



Annotating Patient Information

5 Fetal Heart Rate Monitoring

For your notes

Ultrasound (External Method)

NOTE: Refer to the "Maternal/Fetal Monitoring, Clinical Applications Manual" for patient application information.

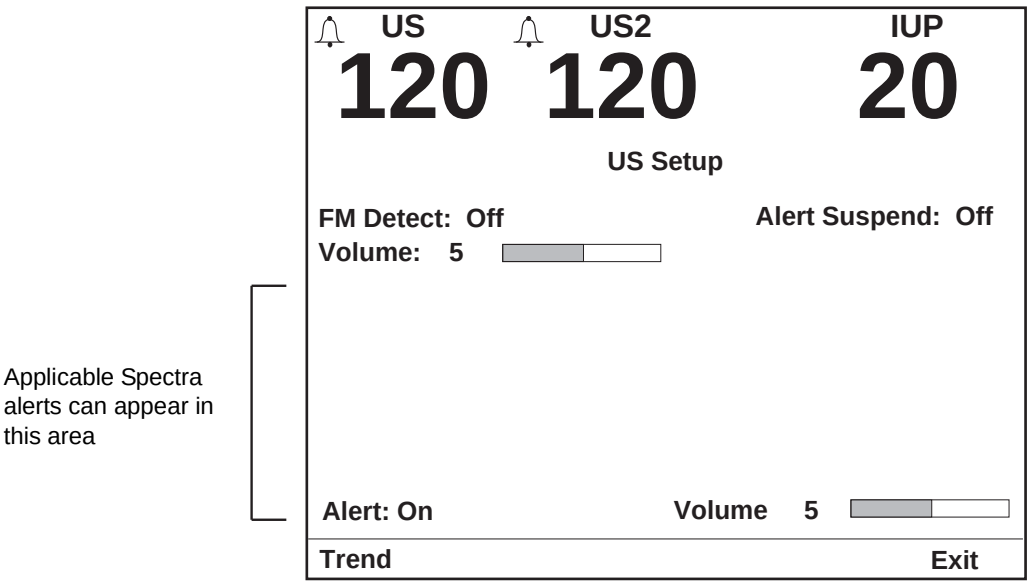
Methodology

An ultrasound (*US*/US2) transducer placed on the maternal abdomen is used to direct an ultrasonic beam toward the fetal heart; the transducer detects Doppler shifted frequency changes in echoes created by moving cardiac structures. An autocorrelation process is used to determine the time interval between successive cardiac cycles.

The fetal heart rate is displayed in bpm and is continuously plotted on the strip chart paper if the recorder is on. (Refer to the "US/US2 Setup Screen" figure below.) The heartbeat indicator flashes for each detected heartbeat.

US/US2 Setup Screen

Select the *US* or *US2* softkey to access the *US*/*US2 Setup* screen below. The title of the screen (*US* vs. *US2*) is dependent on the mode selected when the screen is activated.



US/US2 Setup Screen

Volume

This field adjusts the volume for the FHR derived from the selected mode, US or US2. This field works in conjunction with the front panel Volume buttons.

Alert

This field controls and shows Spectra Alerts. Refer to Appendix C for more information.

Alarm Volume

This field controls the alarm volume for all fetal alarms.

FECG (Internal Method)

Methodology

This method uses an electrode attached directly to the fetal presenting part. The electrode is connected to the cable/legplate secured to the mother. The fetal heart rate is computed based upon the interval between successive R-wave peaks of the fetal QRS complex.

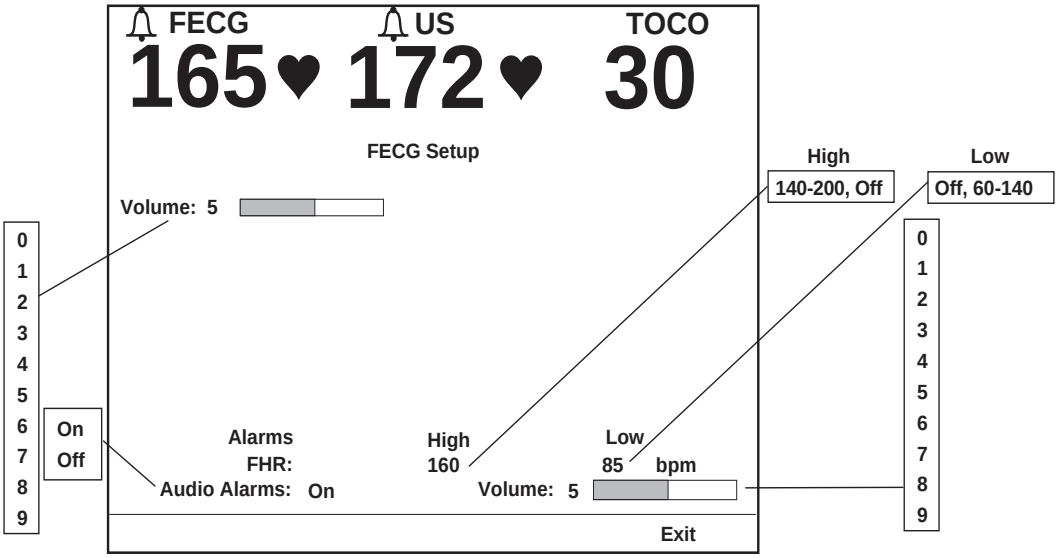
The fetal heart rate is displayed in bpm and is continuously plotted on the strip chart recorder paper if the recorder is on. (Refer to “US/US2 Setup Screen” on page 5-3.) The heartbeat indicator flashes for each detected heartbeat.

Artifact Elimination

An FECG artifact elimination option is available behind the password-protected *Service Lock* screen on all 250cx Series Monitors.

FECG Setup Screen

Select the *FECG* softkey to access the *FECG Setup* screen.



FECG Setup Screen With Fetal Alarms Enabled

Volume

This field controls the volume for the FHR beeps derived from FECG. This field works in conjunction with the front panel Volume buttons.

Alarms

These fields adjust the high and low alarm limits. The available ranges are shown in the above figure; the factory default settings are listed in Appendix A, “Factory Defaults”.

NOTE: The FHR1 and FHR2 alarm limits are set independently of each other.

Audio Alarms

This field enables/disables the audio alarm function for FHR when derived from FECG.

- *On*: Visual and audible indications are provided during an FHR alarm condition.
- *Off*: Only a visual indication is provided during an FHR alarm condition.

Alarm Volume

This field controls the alarm volume for all alarms.

Fetal Heart Rate Alarms

FHR Threshold Alarms

A fetal heart rate *threshold* alarm occurs when any fetal heart rate falls outside of the pre-defined alarm limits—greater than the high limit setting or less than the low limit setting. These alarm limits are configured via the user setup mode; the alarm can be completely disabled as well.

NOTE: The alarm enable/disable setting controls all FHR alarms: high, low, and signal quality.

A threshold alarm is indicated both visually and audibly. Visual indications are provided by the Alarm indicator and the respective heart rate numerics. The audio alarm is described as alternating high-low tones.

CAUTION
Prior to monitoring each patient, it is recommended that you check the alarm status and alarm limits to ensure they are appropriate for the patient. The alarms are disabled if the Alarm Disable indicator is lit; they are enabled if the indicator is unlit.

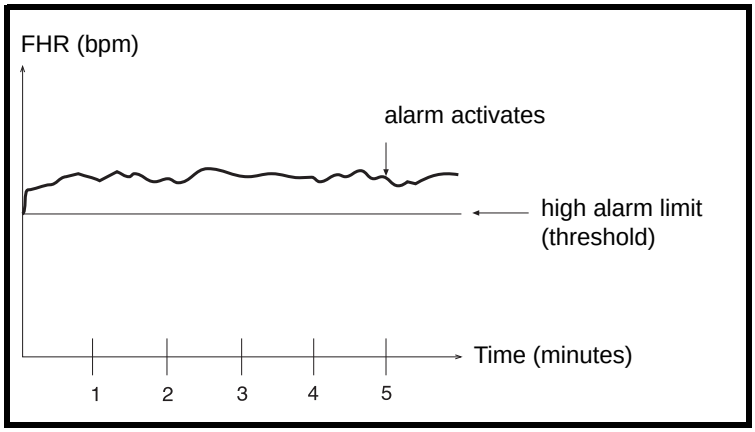
Latching Alarms

Fetal heart rate threshold alarms are “latching.” This means that a clinician must acknowledge the alarm using the monitor’s Alarm Silence button in order to clear the alarm.

- **Active Threshold Alarm:** Press the Alarm Silence button to cancel the audio component of an active threshold alarm. The visual indications remains present until the FHR value returns to within the defined acceptable range.
- **Unsilenced, Resolved Threshold Alarm:** If a threshold alarm condition resolves, prior to being silenced (clinical acknowledgment), the visual and audible indications both remain present. Press the Alarm Silence button to cancel both the audible and visual indications.

FHR High Alarm

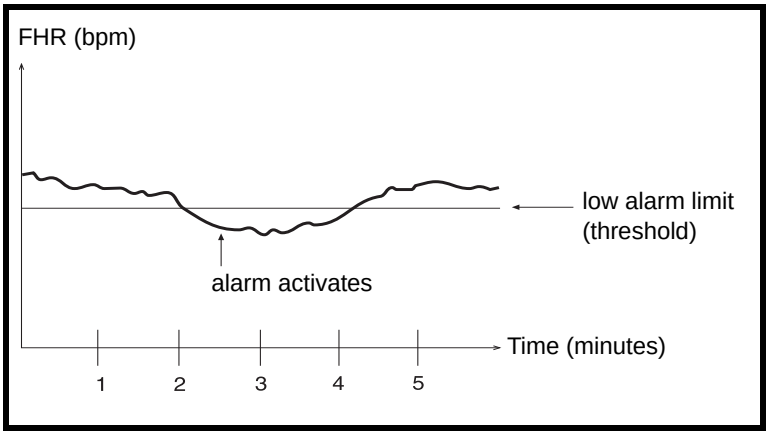
The simplest example of a high FHR alarm occurs when the FHR value is *continuously* greater than the threshold (high limit) for 5 minutes. When data consistently violates the limit, the time-to-alarm is 5 minutes.



High FHR Alarm Example

FHR Low Alarm

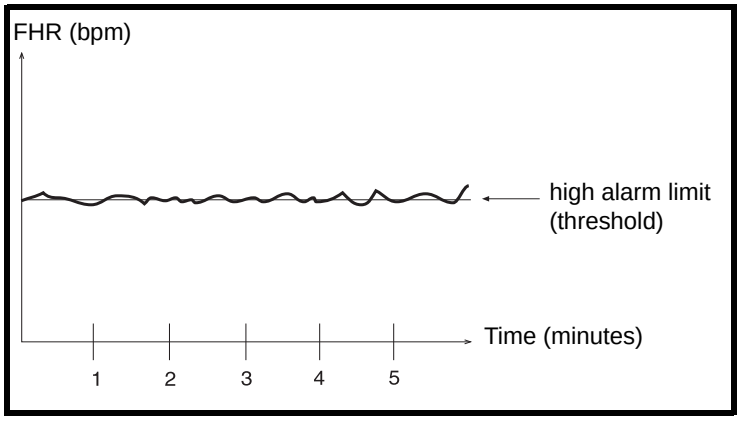
The simplest example of a low FHR alarm occurs when the FHR value is *continuously* less than the threshold (low limit) for 30 seconds. When data consistently violates the limit, the time-to-alarm is 30 seconds.



Low FHR Alarm Example

Sample Clinical Exceptions

The figure below provides an example of FHR fluctuations above and below the high alarm limit setting.



Fluctuations Near High Alarm Limit Example

Whether the pattern shown in the above figure generates an alarm depends on what percentage of the data violates the limit. The monitor evaluates the data on an on-going basis; the methodology can be simplified as follows:

- An FHR threshold alarm occurs if the FHR violates the alarm limit setting for more time than it stays within the specified acceptable range.
- The time-to-alarm increases as a greater percentage of data stays within the specified acceptable range.

Signal Quality Alarms

A fetal heart rate *signal quality* alarm occurs if the monitor is unable to detect an acceptable FHR signal.

Active Signal Quality Alarm

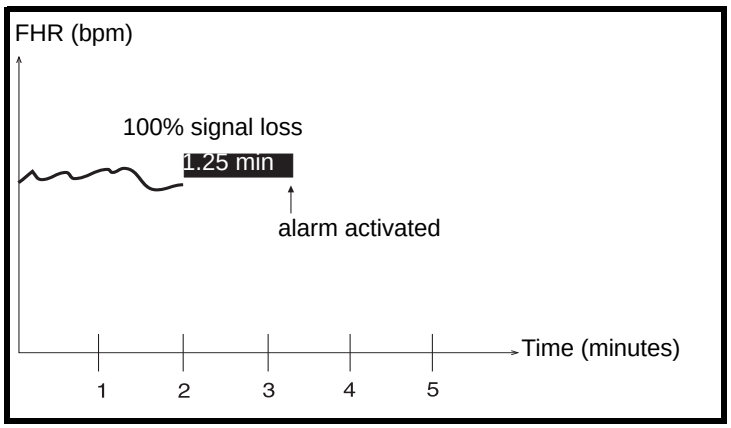
Signal quality alarms are indicated both visually and audibly. Dashes "– – –" display in the affected fetal heart rate display. The audio alarm is described as alternating high-low tones.

Resolved Signal Quality Alarm

As soon as an alarm condition is resolved, both the visual and audible indications *automatically* disappear (unlatch).

100% Signal Loss

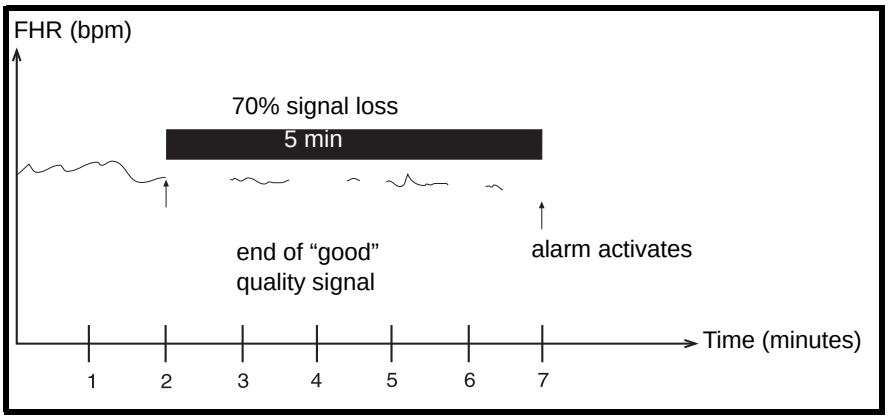
In cases where there is a complete absence of signal, the signal quality time-to-alarm is 1.25 minutes.



100% Signal Loss Example

Intermittent Signal Loss

In the clinical environment, a partial loss of signal is seen more frequently than a complete loss of signal. The time-to-alarm will vary related to the percentage of signal loss. Figure below shows an example where there is 70% signal loss resulting in a signal quality alarm after 5 minutes.



70% Signal Loss Example

Silencing an Audio Alarm

Press the **Alarm Silence** button to cancel the audio component of an alarm; the visual indications remain until the alarm condition is resolved.

The silence function works on an alarm-by-alarm basis. An audio alarm will sound if a new alarm condition occurs after the previous condition has been resolved.

Summary

The alarm algorithms are intended to assist the perinatal staff in assessing the status of a patient at bedside by recognizing vital signs data that falls outside the user-defined normal range. The monitor does not replace observation and evaluation of the mother and fetus at regular intervals by a qualified care provider, who will make diagnoses and decide on treatments or interventions. A provider should determine the status of the patient by visual assessment of the fetal monitor tracing at the bedside and evaluation of fetal and maternal vital signs and progress in labor. The absence of an alarm does not indicate fetal or maternal well-being.

Frequent assessment of the fetal monitor tracing is necessary to ensure recognition of unusual, undefined, or suspicious patterns that may or may not generate a threshold alarm.

Single Fetal Heart Rate Monitoring

The Corometrics 250cx Series monitor offers three options to monitor a single fetal heart rate (FHR):

- US (external)
- US2 (external)
- FECG (internal)

Please refer to the “FHR Display and Trend Summary” Table for FHR display and trend summary.

Dual Fetal Heart Rate Monitoring

The Corometrics 250cx Series monitor is capable of monitoring two fetal heart rates. The discussion in this section is limited to methods of monitoring dual fetal heart rates; however, it is important to note that MECG monitoring can continue during the monitoring of twins -- even when one twin is monitored using FECG. Please refer to the “FHR Display and Trend Summary” Table for FHR display and trend summary.

There are three available options to monitor dual fetal heart rate (FHR).

- US/US2 (dual external)
- FECG/US (internal/external)
- FECG/US2 (internal/external)

The 250cx Series monitor offers two advanced features to aid in monitoring twins:

- heartbeat coincidence
- fetal heart rate offset

FHR Display and Trend Summary				
ACTIVE CONNECTORS	DISPLAY MODE		TREND ANNOTATION	
	FHR1	FHR2	FHR1	FHR2
US	*US*		*US*	
US2	*US2*		*US2*	
FECG	*FECG*		*FECG*	
US, US2	*US*	*US2*	*US*	*US2*
FECG, US	*FECG*	*US*	*FECG*	*US*
FECG, US2	*FECG*	*US2*	*FECG*	*US2*
FECG, US, US2	*FECG*	*US2*	*FECG*	*US2*

NOTE: In the event that three transducers are plugged into the monitor, FECG overrides the primary ultrasound connector (US).

Heartbeat Coincidence

When the heartbeat coincidence feature is enabled, the monitor alerts you when there is the possibility that you may be monitoring a duplicate signal. Refer to Chapter 13, “Heartbeat Coincidence” for more information.

Fetal Heart Rate Offset

When monitoring dual fetal heart rates, overlapping traces on the strip chart may be difficult to interpret. The 250cx Series monitor provides a +20 bpm shift for the secondary FHR trend to alleviate this problem—whether using dual ultrasound or ultrasound and FECG. This field provides an alternative to using the front panel *Mark [Offset]* button. Refer to the service manual for information on enabling/ disabling fetal HR offset.

Activating the Fetal Heart Rate Offset Feature

To shift the secondary FHR trend +20BPM:

1. Ensure the recorder is *on* and two HR channels are activated.
2. Press and hold the Mark [Offset] button for *3 seconds*. (Or use the *US/US2 Setup* screen.)

- When you use dual ultrasound or US2 and FECG, the US2 trace is shifted +20 bpm and the US2+20 symbol prints on the upper portion of the top grid every 4.5 cm.
- When you use US and FECG, the US trace is shifted +20 bpm and the US + 20 symbol prints on the upper portion of the top grid every 4.5 cm.

- A right arrow (→) and a vertical dashed line print to draw attention to the start of the shifted trend.

Refer to "Fetal Heart Rate Offset Example," on page 5-12 for an example of a shifted trend.

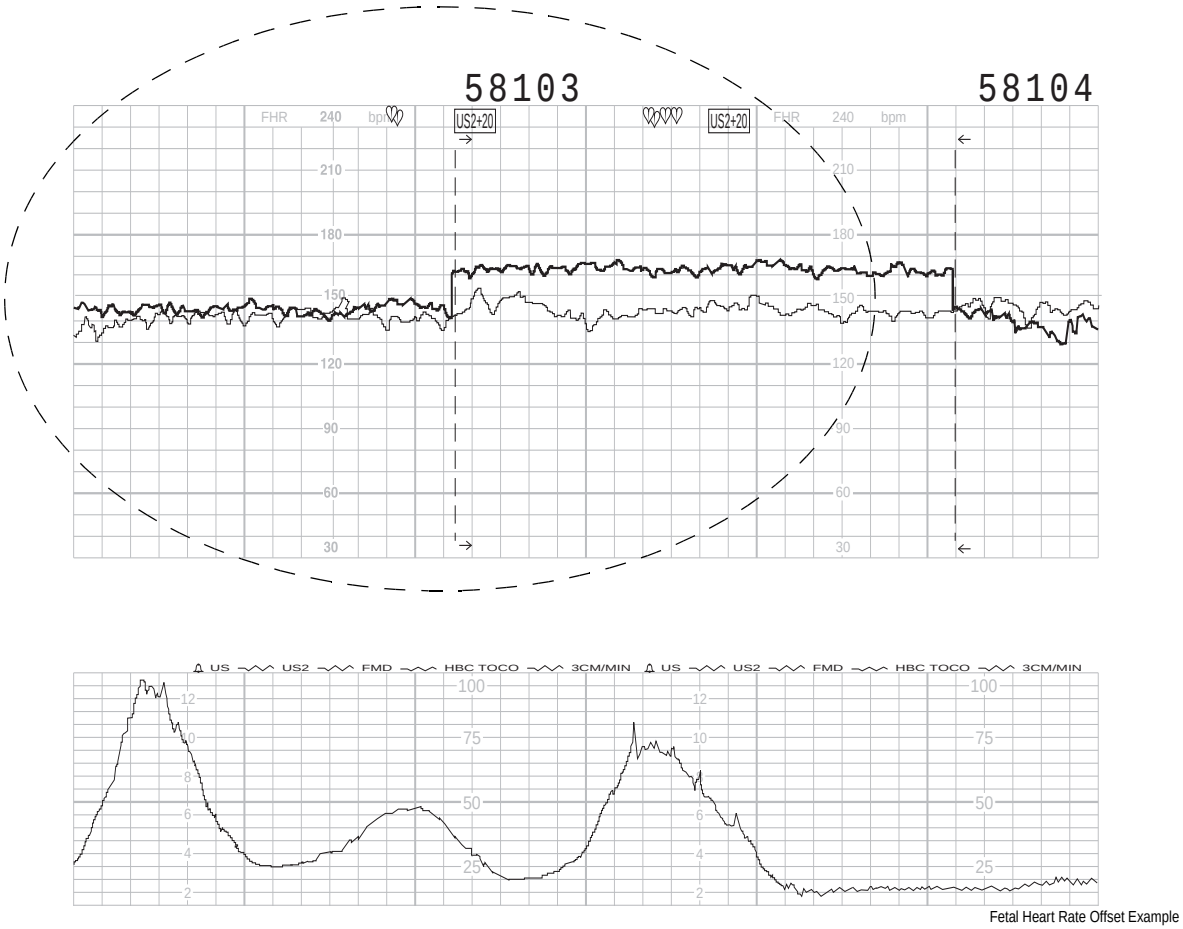
De-Activating the Fetal Heart Rate Offset Feature

After the FHR patterns have been assessed, set the secondary FHR trend back to the normal (unshifted) position.[1]

1. Ensure the recorder is *on*.
2. Press and hold the Mark [Offset] button for *3 seconds*. (Or use the *US/US2 Setup* screen.)
   - The trend returns to the unshifted position.
   - A left arrow (←) and a vertical dashed line print to draw attention to the change.

NOTE: If the auto-revert (*10-min*) setting is selected on the password-protected *Install Options* screen, the shifted heart rate trace automatically reverts to normal after 10 minutes.

[1]Setting the FHR trend to the normal (unshifted) mode does not disable the HR Offset function; it deactivates it. To disable the mode, refer to the 250cx Series Service Manual.



Fetal Heart Rate Offset Example

6 Uterine Activity Monitoring

For your notes

Tocotransducer (External Method)

NOTE: Refer to the "Maternal/Fetal Monitoring, Clinical Applications Manual" for patient application information.

Methodology

A tocotransducer applied to the maternal abdomen records relative changes in abdominal tension caused by uterine contractions. The mode (*TOCO*) and value are shown in the *UA* area of the display. During normal operation, the UA value displays from *0–100* in mmHg mode and 0.0 - 13.3 in kPa mode. Uterine activity is continuously plotted on the bottom (or right) grid of the strip chart paper as a plain black line.

IMPORTANT:
FOR TRIMLINE TOCOTRANSDUCERS ONLY—You must wait at least 10 seconds from the time you power the monitor on or connect a tocotransducer before pressing the UA Reference button.

Establishing a Baseline

Monitoring uterine activity using a tocotransducer provides ***relative*** pressure measurements—compared to a baseline or UA reference. The quality of measurements depends on the following:

- position of the tocotransducer;
- belt tension;
- size of the patient; and
- established baseline.

All 250cx Series Monitors provide a UA Reference button that sets the baseline. When a baseline is established, all pressure measurements are relative to that baseline. The baseline can be set manually by two different methods or automatically, when necessary. Whenever the baseline is set, the bottom line of the bottom strip chart grid is annotated with *UA REF.*

Initial Referencing

The initial reference occurs automatically. After you plug in a transducer, verify that the display reads less than 30 mmHg (4 kPa). Make a note of the reading.

The purpose of establishing a baseline at this point is necessary for consistency when applying and tightening the belt. You will have to set the baseline again, after tightening the belt.

Accounting for Belt Tension

When adjusting the belt on the patient, regardless of transducer type, it is important to ensure a comfortable fit; also, ensure that the transducer is held securely in place. GE Medical Systems *Information Technologies* recommends adjusting the belt tension so that, between contractions, the *UA* display shows approximately 25 mmHg (3.3 kPa) ***above*** the initial baseline.

After the belt is adjusted, it is important to establish a new baseline to prevent belt tension to be counted as uterine pressure; also, pressure readings could tend to go off the scale if belt pressure is not taken into account. Again, the UA Reference button should only be pressed between contractions.

More About Referencing

Out of Range Condition

After you press the UA Reference button, if there is insufficient range to provide at least 100 mmHg (13.3 kPa) above the reference level (probably because the belt is too tight), the *UA* display area flashes the message *CHECK TOCO*. If this happens, remove the tocotransducer from the patient; re-reference with no pressure applied to the button; reapply the transducer adjusting the belt to approximately 25 mmHg (3.3 kPa) ***above*** the baseline; then re-reference one more time. If you still receive the *CHECK TOCO* message, try a different tocotransducer or contact your GE Service Representative.

Manually Setting the Baseline at the Default Value

Briefly pressing the UA Reference button sets the baseline at the *default* setting—the default is configured on the password-protected *Install Options* service screen. The monitor is shipped from the factory with either a *default* setting of 10 in mmHg mode or 1.3 in kPa mode. Qualified personnel can access the password-protected *Install Options* service screen to set the baseline *default* to *5, 10, 15, 20,* or 25 relative units in mmHg mode or *0.7, 1.3, 2.0, 2.7,* or 3.3 in kPa mode. Refer to the "250/250cx Series Monitor Service Manual" for more information.

Manually Overriding the Baseline Default Value

Pressing and holding the UA Reference button for more than 2 seconds causes the UA reference level and display to override the default setting and cycle through all available selections: *5, 10, 15, 20,* or 25 relative units in mmHg mode or *0.7, 1.3, 2.0, 2.7,* or in 3.3 kPa mode, starting at the default setting—until the button is released. Once the button is released, the UA trace and UA value take on this new value as a baseline for reference.

Briefly pressing the UA Reference button reverts back to using the *default* setting configured via the password-protected *Install Options* service screen.

Automatic Baseline "Zeroing"

If pressure falls below 0 mmHg (0 kPa) (probably because the belt has loosened), automatic UA referencing occurs and a new baseline reference is set at 0 relative units.

Internal Method - Intrauterine Pressure (*IUP*)

NOTE: To secure a strain gauge post for IUP monitoring, refer to the strain gauge manufacturer's instructions.

Methodology

An intrauterine pressure catheter (IUPC) inserted transcervically into the uterine cavity measures intrauterine pressure. You can monitor using either a fluid-filled catheter or a transducer-tipped catheter. The mode (*IUP*) and value are shown in the *UA* area of the display. The UA value displays from *0–100* in mmHg mode and 0.0 - 13.3 in kPa mode during normal operation. Uterine activity is continuously plotted on the bottom (or right) grid of the strip chart paper as a plain black line. Pressure exceeding 100 mmHg (13.3 kPa) is printed as a straight line at 100 mmHg (13.3 kPa).

Why You Must Zero the System

When you zero the system, you are referencing the pressure to 0 mmHg (0 kPa) while the system is open to air to ensure an absolute pressure measurement. Refer to the "Maternal/Fetal Monitoring, Clinical Applications Manual" for more information.

- If you disconnect the patient from the monitor all zeroing information is lost. If you re-connect the patient to the monitor you must re-zero—regardless of whether you connect to the same monitor or a different monitor.
- If the mother's position has changed, the baseline may have been altered. If this is the case, re-zero.
- If the message *CHECK IUP* flashes in the *UA* display area, there is insufficient compensation to provide 100 mmHg (13.3 kPa) above the reference level. Re-zeroing should correct the problem.
- If a negative value is displayed (pressure less than 0 mmHg (0 kPa), the baseline should be re-zeroed. (When a negative value occurs for more than 20 seconds, the message *BASELINE PRESSURE OFFSCALE* is on the bottom grid on the strip chart paper.)

7 Maternal Heart/Pulse Rate Monitoring

For your notes

MHR/P Source

The MHR/P can be determined by the MECG, $MSpO_2$, and NIBP sections of the monitor. However, the data from only one parameter is:

- referred to as the MHR/P source
- displayed in the MHR/P area;
- used to evaluate an MHR/P alarm condition; and
- used to generate the MHR/P trace on the strip chart paper.[1]

The source is:

- selected via the MHR/P Setup screen
- may be manually selected or automatically selected by the monitor according to the following priority order:
  - MECG (values updated continuously)
  - $MSpO_2$ (values updated continuously)
  - NIBP (NIBP is available only as an *Auto* selection; the *Manual* selection is disabled. Values updated only when NIBP determinations are taken)

IMPORTANT:
$MSpO_2$ AS AN MHR/P SOURCE—If $MSpO_2$ is selected as the MHR/P source, an MHR/P alarm only occurs if the pulse rate value derived from the $MSpO_2$ sensor violates an MHR/P alarm limit. The MHR/P values derived from the MECG and NIBP sections of the monitor are ignored. The heart rate tone varies in pitch to reflect changes in the maternal oxygen saturation reading. The pitch rises as the saturation values increase, and lowers as the saturation values decrease. The pulse rate trend is a grey line annotated by $MSpO_2P$ ≈.

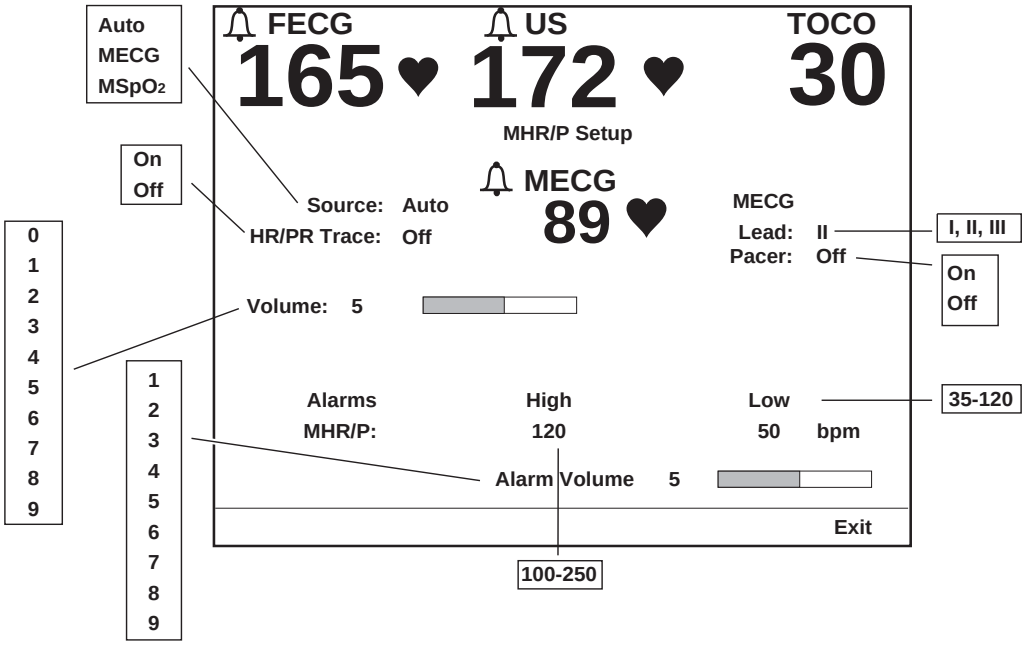
[1] If NIBP is selected as the MHR/P source, there is no trending of the data since these are static measurements.

MHR/P Setup Screen

Select the mode title softkey—*MECG* or *Pulse*—to access the MHR/P Setup screen. (Refer to the following figure.)

NOTES

- The figure below provides an example of MECG selected as the MHR/P source, as indicated by the *MECG* mode title. When either $MSpO_2$ or NIBP are selected as the MHR/P source, the mode title changes to *Pulse*.
- The *Lead* source and *Pacer* fields apply to MECG only.



MHR/P Setup Screen

Source

This field selects the MHR/P source. When *Auto* is selected, the monitor checks for parameter availability and use in the following order: MECG, $MSpO_2$, then NIBP. If a source is not available, the next available source is automatically selected.

IMPORTANT

WAVEFORM—The MHR/P *Source* field is independent of the waveform selected on the normal operating screen. For example, you can select MECG as the MHR/P source yet display the $MSpO_2$ plethysmograph waveform. Or, you can select $MSpO_2$ as the source and display MECG as the waveform.

HR/PR Trace

This field enables or disables the printing of the MHR/P trace on the strip chart paper.

- *On*: The MHR/P trend is printed in grey annotated with MECG ≈ or $MSpO_2$ P ≈—whichever parameter is selected in the MHR/P *Source* field. MHR/P data from NIBP is not trended since blood pressure determinations are static measurements.
- *Off*: The MHR/P trend is not printed.

Volume

This field sets the volume of the “beep” sounded with each detected valid heartbeat—for MECG and $MSpO_2$ only.

Alarms

These fields adjust the high and low alarm limits for MHR/P— in increments of 5 bpm. The selectable values are shown in the MHR/P Setup screen. The factory defaults are listed in Appendix A, “Factory Defaults”.

Alarm Volume

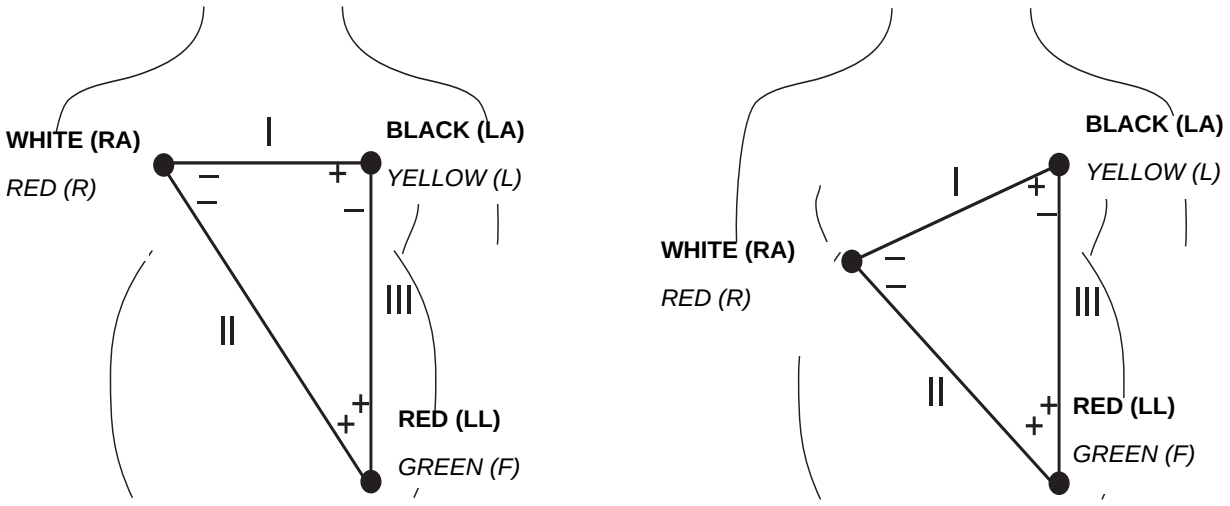
This field controls alarm volume for all maternal alarms.

MECG Lead

This field selects the ECG lead configuration. The lead can also be selected from the MECG *Lead* Softkey on the normal operating screen.

- *Lead I* refers to the potential between the left arm and the right arm.
- *Lead II* refers to the potential between the right arm and left leg.
- *Lead III* refers to the potential between the left arm and the left leg.

The following figure illustrates which electrodes reference the ECG lead obtained.



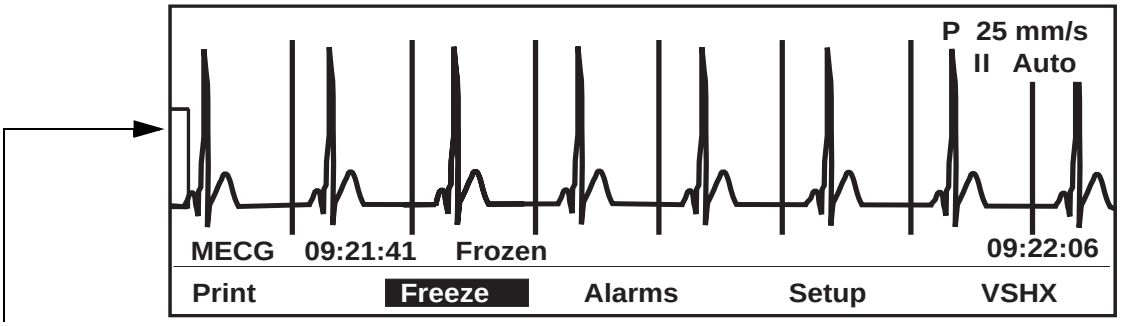
NOTE: AHA label is **bolded**; IEC label is *italicized.*

MECG Lead Selection Guide

MECG Pacer

This field enables/disables pacemaker pulse rejection circuitry.

- *Off*: Use this setting for a patient without a pacemaker. All ECG events are monitored; all complexes, including pacer spikes may be displayed[1] and may be included in the heart rate calculation.
- *On*: Use this setting for a patient who has a pacemaker. The monitor rejects the pacer spike from the heart rate calculation and replaces the actual pacer spike[1] with a pacer event mark; in addition the letter **P** is displayed prior to the waveform speed. Following is an example of an MECG waveform with the MECG pacer *On*.



The bracket situated to the left of the ECG waveform denotes 1 mv. If the ECG waveform size is set to *Auto*, the bracket will auto-adjust to maximize the QRS display, depending on signal amplitude.

MECG Waveform with Pacer Enabled

[1] If the MECG waveform is enabled for display

Maternal ECG Monitoring

Theory and Methodology

The maternal heart rate (MHR) is measured via electrodes placed on the maternal chest. When MECG is employed, the maternal heart rate is computed on a beat-to-beat basis using the R-to-R time interval on the maternal QRS complex. When MECG is selected as the MHR/P source, the MHR is displayed on the front panel display in beats per minutes (bpm), denoted by *MECG*. The heartbeat indicator ♥ flashes for each detected heartbeat. The rear panel speaker emits an audible tone for each detected heartbeat. The maternal heart rate trend, when enabled, is continuously plotted in the top (or left) grid of the strip chart paper. The MHR trace is a grey line annotated by *MECG* ≈. The *beat-to-beat* MHR signal is used for trending on the strip chart paper and for output to external devices such as a central station system. The *averaged* MHR values are used for display and for alarm detection.

Pacemaker Safety Information

The following safety information applies to patients with pacemakers.

WARNINGS

ACCESSORIES—Use only electrodes, lead wires, and cables recommended by GE Medical Systems Information Technologies. Failure to use recommended accessories may result in inaccurate readings, damage to equipment, or loss of defibrillator protection.

FALSE ALARMS—False low heart rate alarms or false asystole may result with certain pacemakers because of electrical overshoot.

FALSE COUNTING—Be aware that a pacer spike could be falsely counted as a QRS complex during asystole.

INTERFERENCE—Interference caused by electrosurgical or diathermy instruments will affect the proper operation of the MECG section of 250cx Series Monitors.

PACEMAKER SPIKE—Do not diagnostically interpret the pacemaker spike size and shape; the spike may be attenuated by the module in order to be displayed or printed.

PATIENT OBSERVATION—Keep pacemaker patients under close observation.

CAUTION•

FDA POSTMARKET SAFETY ALERT—the United States FDA Center for Devices and Radiological Health issued a safety bulletin October 14, 1998. This bulletin states “that minute ventilation rate-adaptive implantable pacemakers can occasionally interact with certain cardiac monitoring and diagnostic equipment, causing the pacemakers to pace at their maximum programmed rate.” The FDA further recommends precautions to take into consideration for patients with these types of pacemakers. These precautions include disabling the rate responsive mode and enabling an alternate pace mode. For more information contact:
Office of Surveillance and Biometrics, CDRH, FDA
1350 Piccard Drive, Mail Stop HFZ-510
Rockville, MD 20850
USA

MECG Waveform

When MECG monitoring is employed, the MECG waveform can be displayed and printed—independent of the MHR/P source. Refer to Chapter 14, “Waveforms”.

8 Maternal Non-Invasive Blood Pressure Monitoring

For your notes

Blood Pressure Safety Precautions

NOTES

- This safety information applies to the non-invasive blood pressure (NIBP) of the monitor.
- A patient's vital signs may vary dramatically during the use of cardiovascular agents such as those that raise or lower blood pressure or those that increase or decrease heart rate.

CAUTIONS

Accuracy of NIBP measurement depends on using a cuff of the proper size. It is essential to measure the circumference of the limb and choose the proper cuff size.

ACCURACY—As with any non-invasive oscillometric blood pressure monitor, there are clinical conditions which can affect the accuracy of the measurements obtained. For example, do not use the monitor's NIBP feature on a patient experiencing convulsions or who is attached to a heart/lung machine. In addition, disregard or stop automatic blood pressure determinations that coincide with maternal contractions. Finally, be aware that the accuracy of measurements can be affected if readings coincide with maternal uterine contractions. Refer to "Smart BP Feature" on page 8-13.

CALIBRATION—Do not operate the monitor unless it has been properly calibrated. Inaccurate blood pressure readings may result. Refer to Chapter 15, "Maintenance" for details.

DISPLAY INTERVAL—The time period, in minutes, that a blood pressure reading remains displayed before being automatically erased, is selectable via the password-protected *Install Options Screen 2.* The option can also be set to continuously display the reading until replaced by a new reading. The display of "old" pressure values may cause confusion. If a patient's condition changes during the time interval between determinations, the monitor will not detect the change or indicate an alarm condition. Blood pressure and pulse can fluctuate greatly between measurements; the monitor does not alert the user (through audio or visual means) to changes in NIBP or NIBP-derived pulse rate occurring between measurement cycles.

EXTERNAL PRESSURE—Do not apply external pressure against the cuff while monitoring. Doing so may cause inaccurate blood pressure values.

CAUTIONS

PULSE RATE COMPARISONS—The pulse rate measured by the monitor's NIBP circuitry may differ from the heart rate measured by the monitor's MECG circuitry or another maternal ECG monitor because the monitor's blood pressure module measures peripheral pulses, not electrical signals or contractions of the heart. Occasionally, the electrical signals at the heart do not produce a peripheral pulse. Similarly, if a patient's beat-to-beat pulse amplitude varies significantly, blood pressure and pulse rate readings can be erratic and an alternate measuring method should be used for confirmation.

Warnings

WARNINGS

The NIBP parameter will not measure blood pressure effectively on patients who are experiencing seizures or tremors. Arrhythmias will increase the time required by the NIBP parameter to determine a blood pressure and may extend the time beyond the capabilities of the parameter.

Use care when placing the cuff on an extremity used to monitor other patient parameters.

The monitor is intended only for use in the non-invasive monitoring of maternal blood pressure (NIBP). This monitor is not intended for use in neonatal or pediatric blood pressure monitoring.

Devices that exert pressure on tissue have been associated with purpura, skin avulsion, compartmental syndrome, ischemia, and/or neuropathy. To minimize these potential problems, especially when monitoring at frequent intervals or over extended periods of time, make sure the cuff is applied appropriately and examine the cuff site and the limb distal to the cuff regularly for signs of impeded blood flow.

NIBP Determination

A patient's vital signs may vary dramatically during the use of cardiovascular agents such as those that raise or lower blood pressure or those that increase or decrease heart rate.

Because treatment protocol based on the patient's blood pressure may rely on specific values and differing measurement methods, clinicians should note a possible variance from values obtained with this unit in planning patient care management. The GE monitor values are based on the oscillometric method of noninvasive blood pressure measurement and correspond to comparisons with intra-aortic values within ANSI/ AAMI Standards for accuracy. Most automatic non-invasive blood pressure monitoring uses the oscillometric method of measurement. To understand how this method works, it is compared to the auscultatory method.

Auscultatory – With the auscultatory method, the clinician listens to the blood flow and determines the systolic and diastolic pressures. The mean pressure is then calculated with reference to these pressures (as long as the arterial pressure curve is normal).

Oscillometric – The oscillometric method measures cuff pressure oscillations. Oscillations are small changes in cuff pressure caused by artery motion against the cuff. During a determination, the monitor stores oscillations along with cuff pressures. At the end of a determination, these stored data are used to determine systolic, mean and diastolic pressures.

Due to the difference in these methods, one cannot be used to check the accuracy of the other.

SuperSTAT NIBP Determination

The oscillometric method of determining SuperSTAT NIBP is accomplished by a sensitive transducer which measures cuff pressure and minute pressure oscillations within the cuff. The first determination initially pumps up to an initial target cuff pressure of about 135 mmHg (18.0 kPa) or to the user-selected initial target pressure. To allow for rapid setting of cuff pressure, the monitor will momentarily inflate to a higher pressure, then immediately deflate to the target pressure.

After inflating the cuff, the monitor begins to deflate, the oscillations versus cuff pressure are measured, and finally, systolic, mean, and diastolic pressure are determined, and the screen is updated. In any subsequent determination, as few as four pressure steps may be necessary to complete the process. When employing fewer pressure steps, the system uses the stored information from the previous blood pressure determination to decide the best pressure steps to take. The monitor measures the consistency of pulse size to tell if the oscillations taken at a step are good and if more steps are needed.

If the current blood pressure reading is similar to the previous reading, the monitor may use some information from the previous blood pressure in the current determination. The monitor constantly evaluates data during a measurement and tries to perform a blood pressure determination in the shortest possible time providing greater comfort to the patient.

Accelerated Determination

The monitor will try to make an accelerated determination of blood pressure if it has been 16 minutes or less since the last determination and the current blood pressure is similar to the previous reading.

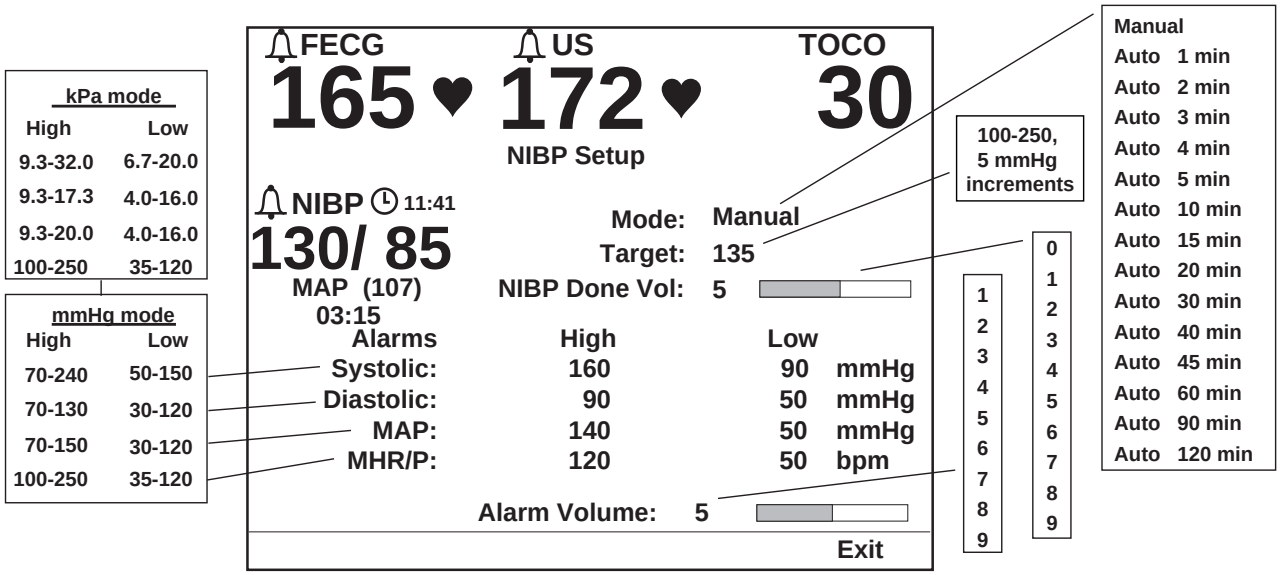
Systolic Search

If systolic pressure is not found, the NIBP parameter can search at cuff pressures higher than the initial target pressure. The parameter will inflate the cuff above the initial target pressure to get data in the systolic region. The maximum pressure allowed in systolic search is limited by the normal range for cuff pressures. In any operating mode, if a patient's systolic pressure exceeds the inflation pressure, the parameter will begin normal deflation sequence, detect the absence of a systolic value, stop deflation, reinflate to a higher (than initial) inflation pressure, and resume the normal deflation sequence.

WARNING
Arrhythmias will increase the time required by the NIBP parameter to determine a blood pressure.

NIBP Setup Screen

Select the *NIBP* softkey to access the *NIBP Setup* screen.



Maternal *NIBP Setup* Screen

Mode

This field alternates between the manual and automatic monitoring modes for maternal blood pressure. For auto mode, this field also sets the interval time, in minutes, between automatic blood pressure determinations. This interval time is measured from beginning to beginning of determinations. (The monitor is factory-set with the optional 1-minute interval time enabled. For information on disabling the 1-minute interval, refer to the "250/250cx Series Monitor Service Manual".)

NOTE: As soon as the auto mode is selected on the setup screen, the countdown timer begins to decrement. *The first automatic determination begins after expiration of one complete interval time period.*

Target

This option lets you choose the initial pressure for cuff inflation. If the NIBP is taken while previous determination is still displayed, and within 16 minutes of the previous determination, the initial target pressures for subsequent determinations are based upon the systolic values of previous determination. The default initial target pressure is 135 mmHg (18.0 kPa). Adjust the pressure between 100 to 250 mmHg (13.3 to 33.3 kPa) in increments of 5 mmHg (0.7 kPa).

NOTE: Selecting a target pressure will clear old NIBP values in the vital signs area and cancel any determination in progress.

NIBP Done Volume

This field sets the volume of the sound emitted at the completion of each blood pressure determination. As you adjust the volume, a sample tone sounds.

Alarms

These fields adjust the high and low alarm limits for maternal systolic, diastolic, and mean arterial pressures, as well as for MHR/P—in increments of 5 mmHg (0.7 kPa) or 5 bpm. The selectable values are listed in "Maternal NIBP Setup Screen," on page 8-7. The factory default settings are listed in Appendix A, "Factory Defaults".

Alarm Volume

This field controls alarm volume for all maternal alarms.

NIBP Monitoring

Checklist

1. The NIBP hose is securely inserted into the NIBP connector on the monitor.
2. A cuff appropriate for the limb size has been selected.
3. Cuff is properly placed on patient and connected to the NIBP hose.
4. Tubes between the cuff and the monitor are not kinked or blocked.

Patient Preparation

Cuff selection and application are important. Inappropriate selection or improper application of the cuff will result in erroneous measurements.

WARNING
The system is designed for use only with dual-hose cuffs and tubing.

Do not place the cuff on a limb being used for A-V fistulas, intravenous infusion or on any area where circulation is compromised or has the potential to be compromised.

1. Connect the air hose to the NIBP port on the front of the monitor. Make sure that the hose is not kinked or compressed.
2. Choose the appropriate blood pressure measurement site. Because normative values are generally based on this site and as a matter of convenience, the upper arm is preferred. When upper arm size or shape or the patient's clinical condition or other factors prohibit use of the upper arm, the clinician must plan patient care accordingly, taking into account the patient's cardiovascular status

and the effect of an alternative site on blood pressure values, proper cuff size and comfort.
Warning: Do not place the cuff on a limb being used for intravenous infusion or any area where circulation is compromised or has the potential to be compromised.

3. If patient is standing, sitting, or inclined ensure that cuffed limb is supported to maintain cuff at level of patient's heart. If cuff is not at heart level, the difference in systolic and diastolic values due to hydrostatic effect must be considered. Add 1.80 mmHg (0.24 kPa) to values for every inch (2.54 cm) above heart level. Subtract 1.80 mmHg (0.24 kPa) from values for every inch (2.54 cm) below heart level.
4. Choose appropriate cuff size. Measure patient's limb and choose appropriately sized cuff according to size marked on cuff or cuff packaging. When cuff sizes overlap for a specified limb circumference, choose the larger size cuff.
Precaution: Accuracy depends on use of proper size cuff.
5. Inspect cuff for damage. Replace cuff when aging, tearing or weak closure is apparent. Do not inflate cuff when unwrapped.
Precaution: Do not use cuff if structural integrity is suspect.
6. Connect the cuff to the air hose.
Warning: It is mandatory that the appropriate hose and cuff combination be used.
7. Inspect patient's limb prior to application.
Precaution: Do not apply cuff to areas where skin is not intact or tissue is injured.
8. Palpate artery and place cuff so that patient's artery is aligned with cuff arrow marked "artery."
9. Squeeze all air from cuff and confirm that connection is secure and unoccluded and that tubing is not kinked.
10. Wrap cuff snugly around the patient's limb. Cuff index line must fall within range markings. Ensure that hook and loop closures are properly engaged so that pressure is evenly distributed throughout cuff. If upper arm is used, place cuff as far proximally as possible.
11. Proper cuff wrapping should be snug, but should still allow space for a finger between patient and cuff. Cuff should not be so tight as to prevent venous return between determinations.
Warning: Using a cuff that is too tight will cause venous congestion and discoloration of the limb, but using a cuff that is too loose may result in no readings and/or inaccurate readings.

Blood Pressure Methodology

During a determination, the instantaneous cuff pressure is indicated by a numeric value displayed beside the title *Cuff*. This information is displayed in place of the mean arterial pressure. When a determination is successful, the monitor emits two short tones (high/low) and displays the three pressure readings (and the maternal pulse, if NIBP is enabled as the MHR/P source.) Refer to Chapter 7, "Maternal Heart/Pulse Rate Monitoring", for information.

Regardless of the mode, auto or manual, the values remain displayed according to the time period specified in the display timer field.

The systolic and diastolic pressures are each indicated with two or three digits and separated by a slash (/). The mean arterial pressure is indicated with two or three digits and enclosed in parentheses. All pressure values are displayed in mmHg or kPa.

Systolic, diastolic, MAP, and pulse rate values are printed on the strip chart paper annotated by an outlined diamond (◊)which marks the time of the reading.

Hydrostatic Effect

If patient is standing, sitting, or inclined ensure that cuffed limb is supported to maintain cuff at level of patient's heart. If cuff is not at heart level, the difference in systolic and diastolic values due to hydrostatic effect must be considered. Add 1.80 mmHg (0.24 kPa) to values for every inch (2.54 cm) above heart level. Subtract 1.80 mmHg (0.24 kPa) from values for every inch (2.54 cm) below heart level.

Manual Mode

In manual mode, press the NIBP Start/Stop button to begin a single determination. The cuff will inflate to the target pressure. If this initial inflation pressure is insufficient, the unit retries with a higher inflation pressure (+40 mmHg; +5.3 kPa). The instantaneous cuff pressure is displayed in place of the mean arterial pressure area and is indicated by the title *Cuff*.

If you have the 256 Monitor–which does not have the NIBP parameter installed–and press the NIBP Start/Stop button, the message *NOT INSTALLED* appears under the *NIBP* label on the monitor's screen.

Automatic Mode

In auto mode an indefinite series of determinations are made at defined time intervals. Upon activation, a clock icon (◷) displays in the *NIBP* area indicating the time remaining until the next scheduled automatic determination.

NOTE: The first automatic determination begins after the *expiration* of one complete interval time period.

Since the first automatic blood pressure reading will not occur until after a complete interval time, you may wish to take an initial manual reading by pressing the NIBP Start/Stop push button. Automatic determinations inflate to the target pressure if no previous values are displayed. If previous values are displayed the cuff inflation target pressure is based on the previous values. If this initial inflation pressure is insufficient, the unit retries with a higher inflation pressure. The instantaneous cuff pressure is displayed in place of the mean arterial pressure area and is indicated by the title *Cuff*.

WARNING
The NIBP parameter should be set to determine blood pressures only as frequently as is clinically indicated to ensure adequate patient monitoring.

Taking a Manual Reading Between Auto Determinations

If the NIBP Start/Stop button is pressed during the interval time between automatic readings, a new determination is initiated.

IMPORTANT:
The countdown timer is ***not*** reset whenever a manual blood pressure reading is initiated; the next scheduled automatic determination will take place as planned.

Venous Return in Auto Mode

When in auto mode, the monitor always waits ***at least 30 seconds*** from the end of one blood pressure determination to the beginning of the next. This provides a minimum time that pressure around the patient's limb is relieved, to allow for venous return.

At all settings except 1 minute, if a determination ends with less than 30 seconds remaining until the next one, that next determination will be cancelled.

NOTE: The 250cx Series Monitor is factory-set with the optional 1-minute interval time enabled. For information on disabling the 1-minute interval, refer to the 250/250cx Series Service Manual.

Example 1. The auto mode is selected with a time interval of 2 minutes. A determination begins at 12:00:00. Due to excessive patient movement, the determination ends at 12:01:35. This leaves only 25 seconds until the next automatic reading scheduled at 12:02:00. The 12:02:00 determination is cancelled and the *following* reading will resume at 12:04:00.

The optional 1-minute interval is an exception. When 1 minute is selected, if a determination ends with less than 30 seconds until the next one, the reading will be delayed to guarantee 30 seconds between determinations. During the delay, *Wait* appears in the Auto mode timer.

Example 2. The auto mode is selected with a time interval of 1 minute. An automatic determination begins at 11:59:00 with the next reading therefore scheduled for 12:00:00. The 11:59:00 determination ends at 11:59:35. This leaves only 25 seconds until the next scheduled automatic reading. Instead of being cancelled, the next reading is reset to start in 30 seconds at 12:00:05. The additional 5 seconds displays as *Wait*.

Adjusting the Interval Time Between Automatic Determinations

You can adjust the interval time in-between determinations by going back into the maternal *NIBP Setup* screen. Regardless of whether you are increasing or decreasing the interval time, the countdown timer resets to the new value. The next automatic reading will occur after the expiration of the new interval.

Example 1. The interval time is set at 10 minutes and the countdown timer shows 4 minutes until the next reading — in other words 6 minutes have elapsed. If you change the interval time to 15 minutes, the countdown timer will wait another 15 minutes until the next reading. Therefore a total of 21 minutes will elapse between readings.

Example 2. The interval time is set at 15 minutes and the countdown timer shows 2 minutes until the next reading — in other words 13 minutes have elapsed. If you change the interval time to 10 minutes, the countdown timer will wait another 10 minutes until the next reading. Therefore a total of 23 minutes will elapse between readings.

NIBP Interval Button Shortcut

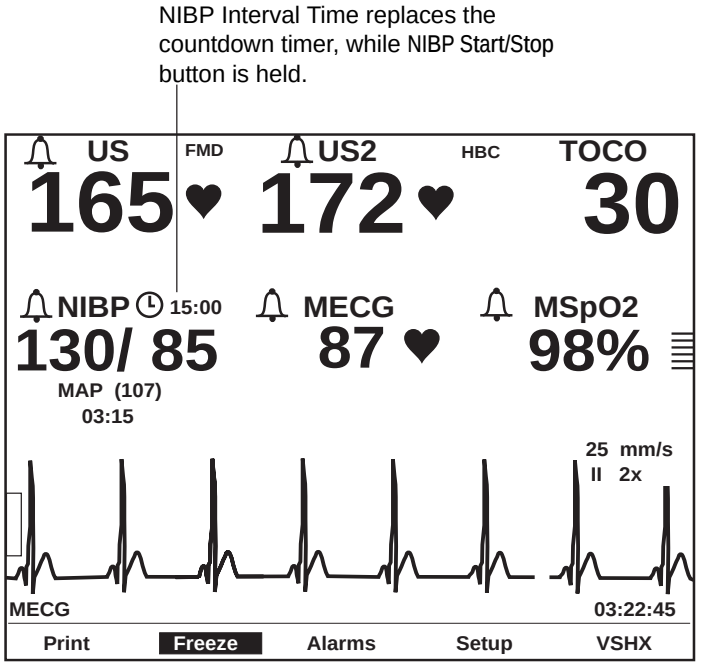
You can set the interval time from the *NIBP Setup* screen *or* from the normal operating screen using a front panel button shortcut:

1. While the normal operating screen is displayed, *press and hold* the NIBP Start/Stop button on the front panel.
2. After holding for approximately 2 seconds, the interval field display in place of the countdown timer. Refer to "NIBP Interval Time Shortcut," on page 8-12.
3. Continuous pressure on the NIBP Start/Stop button cycles through the available intervals: *1, 2, 3, 4, 5, 10, 15, 20, 30, 40, 45, 60, 90,* and *120 minutes*, and *Off*. *Off* appears as a blank in the interval field display.

NOTES

- Since the intervals are displayed in the countdown timer area, they appear as follows: *1:00, 2:00, 3:00,... 60:00,* etc.
- The monitor is factory-set with the optional 1-minute interval time enabled. For information on disabling the 1-minute interval, refer to the "250/250cx Series Monitor Service Manual".

4. When the desired interval is displayed, release the NIBP Start/Stop button.
5. The timer reappears and begins to count down from the new value.



NIBP Interval Time Shortcut

Terminating a Determination in Progress

A determination—manual or automatic—can be cancelled by pressing the NIBP Start/Stop button.

- The selected mode (Manual or Auto) remains in effect.
- The next scheduled automatic determination takes place as planned.

Smart BP Feature

The 250cx Series monitor has the patented Smart BP feature that prevents an automatic blood pressure determination from occurring during a uterine contraction. This feature:

- reduces the chances for erroneous vital signs readings; and
- reduces patient discomfort during labor.

Enabling/Disabling Smart BP

The Smart BP feature is enabled/disabled via the password-protected *Install Options* service screen. Refer to the "250/250cx Series Monitor Service Manual" for more information.

Methodology

The Smart BP feature is functional with both TOCO and IUP monitoring when:

- the automatic blood pressure mode is selected; and
- the interval time is set to 5 minutes or greater.

NOTE: Blood pressure readings cannot be postponed indefinitely. The Smart BP feature ensures that a BP reading is completed even in the presence of frequent uterine contractions.

Uterine activity trends are continuously analyzed to recognize patterns of uterine contractions. Once the onset of a contraction is identified:

- An active blood pressure reading automatically stops and the cuff deflates; it will be re-started following the contraction.
- A scheduled reading is delayed until after the contraction.

9 Maternal Pulse Oximetry Monitoring

For your notes

$MSpO_2$ Technology

Pulse oximetry is a continuous and non-invasive method of measuring the level of arterial oxygen saturation in blood. The measurement is usually taken by placing a sensor on the adult patient's fingertip. The sensor is connected to the monitor by a patient cable. The sensor collects signal data from the patient and sends it to the monitor.

Pulse oximetry is governed by the following principles:

1. Oxyhemoglobin (oxygenated blood) and deoxyhemoglobin (non-oxygenated blood) differ in their absorption of red and infrared light (spectrophotometry).
2. The amount of arterial blood in tissue changes with your pulse (photoplethysmography).

Therefore, the amount of light absorbed by the varying quantities of arterial blood changes as well. The 250cx Series Monitor measures the maternal oxygen saturation ($MSpO_2$) and pulse rate using the principles of spectrophotometry and plethysmography.

Which Module is Installed?

GE Medical Systems *Information Technologies* offers you the choice of one of the following $MSpO_2$ options:

- Ohmeda Oximetry® Technology
- MASIMO SET® Technology
- Nellcor® Technology

You can identify which $MSpO_2$ technology your monitor contains by referring to the front of the monitor. The $MSpO_2$ technology logo appears next to the lower, right-hand side of the display (example shown below).

Ohmeda Oximetry MASIMO SET® NELLCOR OXIMAX WORKS HERE™

.

Ohmeda, Nellcor, and Masimo Set Labels

Theory of Operation

Ohmeda TruSignal™ Oximetry

TruSignal™ Enhanced SpO_2

Ohmeda's TruSignal Enhanced SpO_2 offers fine performance, especially during challenging conditions of clinical patient motion and low perfusion. With ultra-low-noise technology, TruSignal selects the appropriate clinically-developed algorithm to correct weak signals and generate reliable saturation readings. The waveform update rate is 48 Hz. SpO_2 and pulse rate are continuously calculated using a 12-second weighted moving average controlled by priority in the TruSignal algorithms.

Signal processing

Ohmeda pulse oximetry uses a two-wavelength pulsatile system—red and infrared light—to distinguish between oxyhemoglobin (O_2Hb) and reduced hemoglobin (HHb). The light is emitted from the oximeter sensor, which contains a light source and a photodetector.

- The light source consists of red and infrared light-emitting diodes (LEDs).
- The photodetector is an electronic device that produces an electrical current proportional to incident light intensity.

The two light wavelengths generated by the LEDs are transmitted through the tissue at the sensor site and are modulated by arterial blood pulsation. The photodetector in the sensor converts the light intensity information into an electronic signal that is processed by the monitor.

Masimo SET®

Signal Processing

The Masimo MS-11 technology uses a two-wavelength pulsatile system to distinguish between oxygenated and deoxygenated blood. Signal data is obtained by passing red (rd) (663 nm wavelength) and infrared (ir) (880 nm wavelength) light through a capillary bed (e.g., a fingertip, a hand, a foot) and measuring changes in light absorption during the pulsatile cycle. The Masimo sensor has red and infrared light-emitting diodes (LEDs) that pass light through the site to a photodiode (photodetector). The photodetector receives the light, converts it into an electronic signal and sends it, via a patient cable, to the $MSpO_2$ parameter for calculation of the patient's functional oxygen saturation and pulse rate.

The MASIMO SET® MS-11 pulse oximeter is based on three principles:

1. Oxyhemoglobin and deoxyhemoglobin differ in their absorption of red and infrared light (spectrophotometry).
2. The volume of arterial blood in tissue and the light absorbed by the blood changes during the pulse (plethysmography).
3. Arterio-venous shunting is highly variable and that fluctuating absorbance by venous blood is a major component of noise during the pulse.

Traditional pulse oximetry assumes that all pulsations in the light absorbance signal are caused by oscillations in the arterial blood volume. This assumes that the blood flow in the region of the sensor passes entirely through the capillary bed rather than through any arterio-venous shunts.

Masimo's principle of operation is that arterio-venous shunting is highly variable and that fluctuating absorbance by venous blood is a major component of noise during the pulse. The Masimo product decomposes red and infrared pulsatile absorbance into an arterial signal plus a noise component and then calculates the ratio of the arterial signals minus the noise.

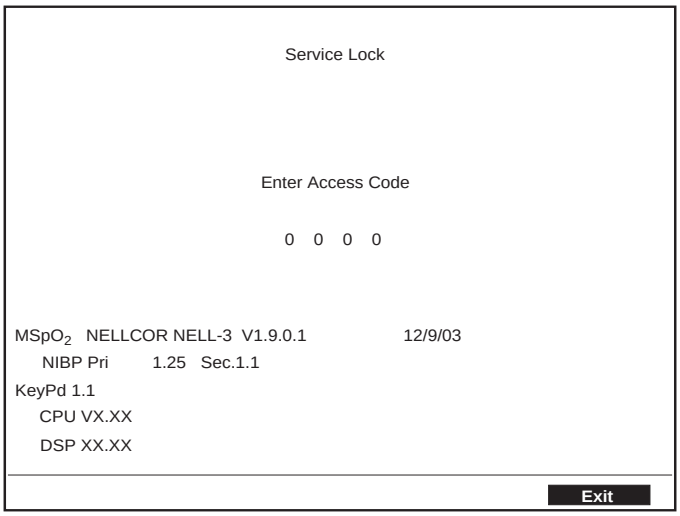
The practitioner can adjust high and low alarm limits to a desired value, if required, and then monitor the waveform, pulse rate and $Sp0_2$ value on the display. If an alarm limit is reached, the information on the display helps to assess the condition of the patient and aids in determining if any intervention is required.

Nellcor OxiMax®

Due to a change in Nellcor technology, the SpO_2 parameter in the Corometrics 250cx Monitor is migrating from Nellcor 506 technology to Nellcor NELL-3 technology. To determine which Nellcor technology your monitor contains, refer to the *Service Lock* screen.

To display the *Service Lock*:

1. Select the *Setup* softkey to display the *General* screen.
2. Select the *Service* softkey from the *General Setup* screen.
3. The *Service Lock* screen appears.



Nellcor uses pulse oximetry to measure functional oxygen saturation in the blood. Pulse oximetry works by applying an OxiMax® sensor to a pulsating arteriolar vascular bed, such as a finger or toe.

The OxiMax sensor contains a dual light source and a photodetector. Bone, tissue, pigmentation, and venous vessels normally absorb a constant amount of light over time. The arteriolar bed normally pulsates and absorbs variable amounts of light during the pulsations. The ratio of light absorbed is translated into a measurement of functional oxygen saturation (SpO_2).

Because a measurement of SpO_2 is dependent upon light from the OxiMax sensor, excessive ambient light can interfere with this measurement.

Select an appropriate OxiMax sensor, apply it as directed, and observe all warnings and cautions presented in the directions for use accompanying the OxiMax sensor. Clean and remove any substances such as nail polish from the application site. Periodically check to ensure that the OxiMax sensor remains properly positioned on the patient.

High ambient light sources such as surgical lights (especially those with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight can interfere with the performance of an SpO_2 OxiMax sensor. To prevent interference from ambient light, ensure that the OxiMax sensor is properly applied, and cover the OxiMax sensor site with opaque material.

WARNING
Failure to cover the OxiMax sensor site with opaque material in high ambient light conditions may result in inaccurate measurements.

The Nellcor Technology determines SpO_2 by passing red and infrared light into an arteriolar bed and measuring changes in light absorption during the pulsatile cycle. Red and infrared low-voltage light-emitting diodes (LED) in the oximetry OxiMax sensor serve as light sources; a photo diode serves as the photodetector.

To identify the oxygen saturation of arterial hemoglobin, the monitor uses the pulsatile nature of arterial flow. During systole, a new pulse of arterial blood enters the vascular bed, and blood volume and light absorption increase. During diastole, blood volume and light absorption reach their lowest point. The pulse oximeter bases its SpO_2 measurements on the difference between maximum and minimum absorption (measurements at systole and diastole). By doing so, it focuses on light absorption by pulsatile arterial blood, eliminating the effects of nonpulsatile absorbers such as tissue, bone, and venous blood.

Automatic Calibration

Because light absorption by hemoglobin is wavelength dependent and because the mean wavelength of LEDs varies, an oximeter must know the mean wavelength of the OxiMax sensor's red LED to accurately measure SpO_2.

During monitoring, the software selects coefficients that are appropriate for the wavelength of that individual OxiMax sensor's red LED; these coefficients are then used to determine SpO_2. Additionally, to compensate for differences in tissue thickness, the light intensity of the OxiMax sensor's LEDs is adjusted automatically.

SatSeconds™

False or nuisance alarms are a common concern in pulse oximetry monitoring. They are often triggered by minor brief desaturation events that are clinically insignificant. *SatSeconds* is a proprietary Nellcor alarm management technique that helps reduce false and nuisance alarms without risking patient safety.

With traditional alarm management, upper and lower alarm limits are set for monitoring oxygen saturation. During monitoring, as soon as an alarm limit is violated by as little as one percentage point, an audible alarm immediately sounds. When the SpO_2 level fluctuates near an alarm limit, the alarm sounds each time the limit is violated.

Such frequent alarms can be distracting. With the *SatSeconds* technique, upper and lower alarm limits are set in the same way as with traditional alarm management. The clinician also sets a *SatSeconds* limit that allows the monitoring of SpO_2 below the selected low alarm limit and SpO_2 above the selected high alarm limit for a period of time before an audible alarm sounds.

The *SatSeconds* limit controls the time that the SpO_2 level may fall outside the alarm before an audible alarm sounds.

The method of calculation is as follows:

The number of percentage points that the SpO_2 falls outside of the alarm limit is multiplied by the number of seconds that the SpO_2 level remains outside that limit. This can be stated as an equation:

Points x Seconds = *SatSeconds*

Where:

- Points = SpO_2 percentage points outside of the limit
- Seconds = number of seconds the SpO_2 remains at that point outside of the limit

The alarm response time, assuming a *SatSeconds* limit set at 50 and a lower alarm limit set at 90, is described and illustrated below.

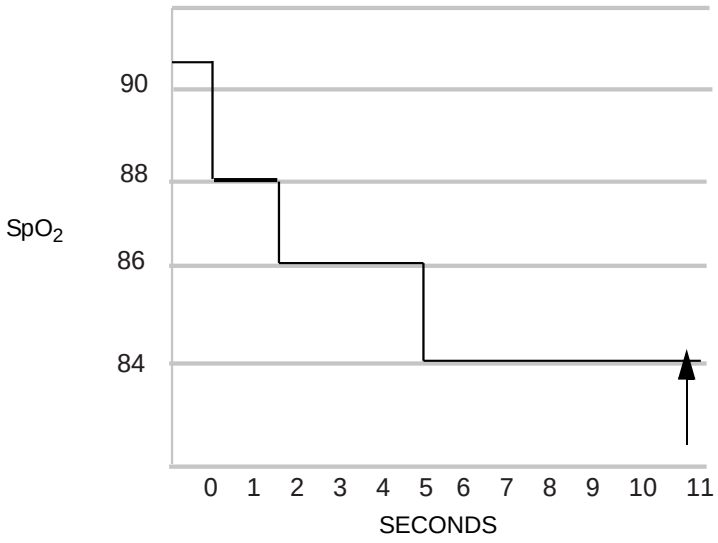
In this example, the SpO_2 level drops to 88 (2 points) and remains there for a period of 2 seconds (2 points x 2 seconds = 4 *SatSeconds*).

The SpO_2 then drops to 86 for 3 seconds and then to 84 for 6 seconds. The resulting *SatSeconds* are:

SpO_2	Seconds	*SatSeconds*
2X	2=	4
4X	3=	12
6X	6=	36
Total *SatSeconds* = 11		52

SatSeconds Calculation

After approximately 10.9 seconds the *SatSeconds* alarm would sound, because 50 *SatSeconds* (the assumed *SatSeconds* limit in this example) had been exceeded.



Alarm Response with *SatSeconds*

Saturation levels may fluctuate rather than remain steady for a period of several seconds. Often, the SpO_2 levels may fluctuate above and below the alarm limit, re-entering the non-alarm range several times.

During such fluctuations, the pulse oximeter integrates the number of SpO_2 points, both positive and negative, until either the *SatSeconds* limit (*SatSeconds* time setting) is reached, or the SpO_2 level returns to within a normal range and remains there.

SatSeconds "Safety Net"

The *SatSeconds* "Safety Net" is for patients with saturation levels having frequent excursions below the limit, but not staying below the limit long enough for the *SatSeconds* time setting to be reached.

Using *SatSeconds*

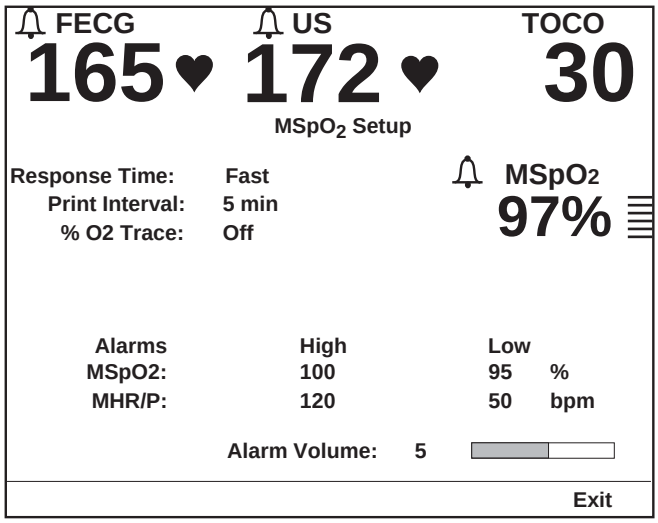
The *SatSeconds* option is located in the Service Mode.To activate *SatSeconds*, your biomed sets the *SatSeconds* limit (*Off, 10, 25, 50,* or *100*) that suits the clinical environment and patient condition. To deactivate *SatSeconds*, your biomed sets the *SatSeconds* limit to *Off*. When it is set to *Off*, the alarm sounds immediately without any delay.

The *SatSeconds* factory default setting is set at *10 SatSeconds.* To change this setting refer to your biomed or 250/250cx Series Service Manual.

IMPORTANT: If you set *SatSeconds* to *Off*, the monitor behavior will change. Any brief desaturation event will cause the monitor to alarm.

$MSpO_2$ Setup Screen

Select the *$MSpO_2$* softkey to access the *$MSpO_2$ Setup* screen. (See figure below.)



Nellcor *$MSpO_2$ Setup* Screen

NOTES

- A Masimo *$MSpO_2$ Setup* Screen differs slightly from the Nellcor Setup Screen. The *Response Time* field is absent, and it is replaced by a *Sensitivity* field followed by an *Averaging Time* field.
- An Ohmeda *$MSpO_2$ Setup* Screen also differs from the above example as the *Response Time* field is absent.

Response Time (Nellcor 506 Technology Only)

Before you begin, confirm which Nellcor Technology your monitor contains. Refer to “Nellcor OxiMax®” on page 9-5 for instructions. Choose a response time mode in order to compensate for different levels of patient activity.

- *Normal:* Useful when patient is unavoidably active, least affected by patient motion.
- *Fast:* Factory default setting. Useful in most clinical situations for relatively inactive patients.

Response Time (Nellcor NELL-3 Technology Only)

Before you begin, confirm which Nellcor Technology your monitor contains. Refer to “Nellcor OxiMax®” on page 9-5 for instructions. If your monitor contains NELL-3, *Fast* is the only available setting.

Sensitivity (Masimo Technology Only)

This menu option appears only when using Masimo Technology and sensor.

- *Normal:* Use the *Normal Sensitivity* setting for normal patient monitoring purposes.
- *Maximum:* Use the *Maximum Sensitivity* setting for improved low perfusion performance and for faster tracking of rapid $MSpO_2$ saturation changes.

Averaging Time (Masimo Technology Only)

This menu option only appears when using Masimo Technology and sensor. Choose a response time in order to compensate for different levels of patient activity: *2*, *4*, *8*, *10*, *12*, *14*, or *16 seconds.*

For the 2 and 4 second averaging settings: The actual averaging times may range from 2 to 4 and 4 to 6 seconds, respectively.

- *10*, *12*, *14*, or *16 seconds:* These averaging settings are least affected by patient movement.
- *8 seconds:* This averaging selection is recommended in cases where the patient is relatively inactive.
- *2* or *4 seconds:* These averaging selections are most affected by patient movement.

Print Interval

This setting determines the time interval for printing the $MSpO_2$ values on the strip chart paper.

$\%O_2$ Trace

This setting enables or disables the printing of the $MSpO_2$ trend on the bottom grid of the strip chart paper.

- *On*: The $MSpO_2$ trend prints in grey and is annotated with *$MSpO_2$*.
- *Off*: The $MSpO_2$ trend is not printed.

Alarms

These fields adjust the high and low alarm limits for $MSpO_2$, as well as for MHR/P—in increments of 1% or 5 bpm. The selectable values are listed in Chapter 10, “Alarms.” Refer to Appendix A, “Factory Defaults” for additional information.

Alarm Volume

This field controls alarm volume for all maternal alarms.

Refer to “Factory Defaults” on page A-1 for information on factory defaults and setting options.

$MSpO_2$ Methodology

The maternal oxygen saturation is indicated by up to three digits representing the percentage of oxygen saturation. The pulse amplitude indicator is a vertical bar that visually indicates each pulse.

When $MSpO_2$ monitoring is employed, the $MSpO_2$ pulsatile (plethysmograph) waveform can be displayed and printed. Refer to Chapter 14, “Waveforms” for more information.

$MSpO_2$ Pulse Beat Audio

If $MSpO_2$ is selected as the MHR/P source, each pulse beat is indicated with a "beep": the pitch of the beep will vary according to the saturation value; the pitch rises as the saturation value increases; the pitch lowers as the saturation value decreases. If MECG is selected as the MHR/P source, the MECG audio *plink* is used instead; it will not vary in pitch. NIBP cannot be chosen as the MHR/P source. (Refer to Chapter 7, "Maternal Heart/Pulse Rate Monitoring" for more information.)

The $MSpO_2$ Waveform

When $MSpO_2$ monitoring is employed, the $MSpO_2$ pulsatile (plethysmograph) waveform can be displayed and printed. Refer to Chapter 14, "Waveforms" for more information.

When enabled, the $MSpO_2$ trend prints in the bottom grid as a grey trace annotated by $MSpO_2$ ⌐⩘⩘. Values are printed on the annotation area preceded by an outlined diamond ◊ which marks the time of the reading.

Module and Probe Compatibility

Ohmeda, Masimo, and Nellcor pulse oximetry parameters are calibrated to display functional saturation. Other manufacturer's pulse oximetry monitors may be calibrated to display fractional saturation.

- 250cx Series Monitors with Masimo Technology are compatible only with Masimo LNOP and LNCS sensors. For additional information, refer to Directions for Use supplied with sensor.
- 250cx Series Monitors with Ohmeda Technology are compatible only with Ohmeda OxiTip+ sensors. For additional information, refer to Directions for Use supplied with sensor.
- 250cx Series Monitors with Nellcor Technology are compatible only with Nellcor OxiMax sensors. For additional information, refer to Directions for Use supplied with sensor.

  IMPORTANT: Use only Masimo LNOP oximetry sensors with the Masimo Technology, Ohmeda sensors with the Ohmeda Technology, and Nellcor sensors with the Nellcor Technology. Other sensors may result in unpredictable performance.

The $MSpO_2$ cable should plug into the monitor's $MSpO_2$ connector easily and securely. Do not use excessive force to connect the cable. If the $MSpO_2$ cable does not easily fit into the $MSpO_2$ connector on the monitor, it is likely that you are using an incorrect cable.

IMPORTANT: It is possible to connect the wrong $MSpO_2$ cable and/or sensor to the monitor. If this happens, the $MSpO_2$ parameter will not work (Ohmeda and Masimo) or will cause an error (Nellcor error: *SENSOR*). Be sure to check the type of $MSpO_2$ technology your monitor contains (the label next to the lower, right-hand side of the display) and use the corresponding cables and sensors for that technology.

Modules and Sensors

The Masimo, Ohmeda, and Nellcor parameters are used to measure the amount of oxygenated hemoglobin and pulse rate non-invasively. The absorption of selected wavelengths of light is measured with sensors. Although these parameters process the $MSpO_2$ measurements differently, the function and appearance of $MSpO_2$ on your monitor is the same.

No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

Sensors

Before use, carefully read the manufacturer's sensor directions for use.

CAUTIONS

TISSUE DAMAGE—Tissue damage can be caused by incorrect application or use of a $MSpO_2$ sensor, for example by wrapping the sensor too tightly. Inspect the sensor site as directed in the sensor's directions for use to ensure skin integrity and correct positioning and adhesion of the sensor.

- ◆Do not use damaged sensors.
- ◆Do not use a sensor with exposed optical components.
- ◆Do not re-sterilize single-patient use sensors. For reusable sensors, refer to the manufacturer's instructions for cleaning and sterilization.
- ◆Do not immerse the patient cable in water, solvents, or cleaning solutions (the patient cable connectors are not waterproof).
- ◆Do not re-sterilize the patient cable by irradiation, steam, or ethylene oxide.

10 Alarms

For your notes

Introduction

This chapter provides a summary of alarms for all modalities in the 250cx Series monitor. The monitor provides patient alarms (alarm limit threshold violations) for:

- FHR1
- FHR2
- NIBP (systolic, diastolic, and mean arterial pressures)
- MHR/P (for the selected source)
- $MSpO_2$

In addition, the monitor provides signal quality alarms.

NOTE: The audio portion of an alarm takes priority to override the song player if activated.

Alarm Setup

Master Alarm Setup Screen

The figure below is a sample *Master Alarm Setup* screen. Although each of the fields on this screen can be accessed under the individual parameter setup screens, the *Master Alarm Setup* screen provides an overall summary of the maternal alarm setup information

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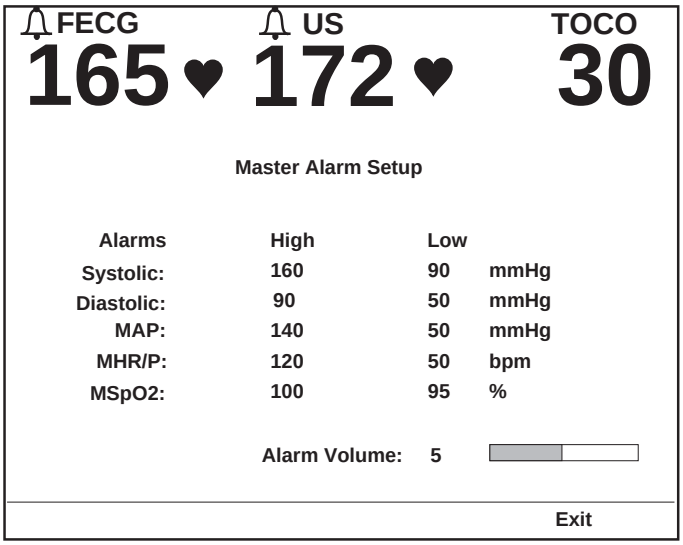


Master Maternal Alarm Setup Screen

Alarms

These fields adjust the high and low alarm limits for NIBP, MHR/P, and $MSpO_2$. The available ranges are shown the “Technical Specifications” section. The factory default setting are listed in Appendix A, “Factory Defaults”.

The alarm limits for each modality are configured by a respective setup screen. Refer to Chapter 4, “Setup Procedures”. A *Master Alarm Setup* screen provides a summary of most alarm limit settings with the exception of the FHR1 and FHR2 limit settings which are set independently.

NOTE: For each modality, the *available* ranges of high and low alarm limits overlap; however, the monitor prevents the *selection* of overlapping alarm limits.

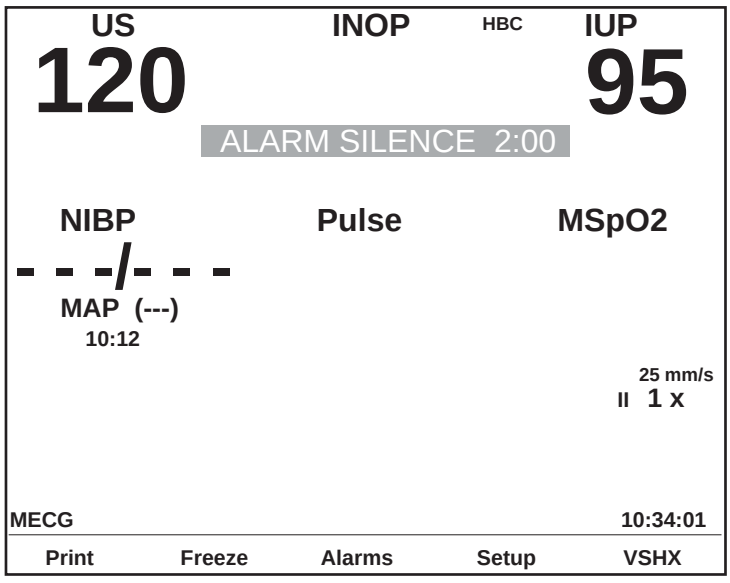
Alarm Volume

The alarm volume can be set on any individual setup screen or on the *Master Alarm Setup* screen. This settings is used for *all alarms*.

CAUTION
ALARM SETUP—Prior to monitoring each patient, it is recommended that you check the alarm limits to ensure they are appropriate for the patient.

Alarm Silence

The figure below is a sample of the *ALARM SILENCE* message on-screen. Press the **Alarm Silence** button to silence an individual maternal audio alarm or paper load error. However, for MECG and $MSpO_2$ monitoring and during a paper-load error condition, an alarm will be reissued if the alarm state continues after a specified amount of time. Once alarm silence is activated, an *ALARM SILENCE* message box appears on-screen with a timer that counts down the remaining time to re-alarm.



Alarm Silence Message On-Screen

Alarm Setting Indicators

An alarm setting indicator displays for FHR1, FHR2, NIBP, MHR/P, and $MSpO_2$. The following table provides a summary of the two possible states for this indicator

NOTE: The FHR alarms may be completely disabled from the password-protected *Install Options* service screen. When disabled, the alarm setting indicator is not displayed.

.

Alarm Setting Indicators		
Mode	All of the following are true:	At least one of the following is true:
FHR	■ The FHR audio alarm is on. ■ Each of the FHR high/low limits is set to a value.	■ The FHR audio alarm is off. ■ The FHR high limit is off. ■ The FHR low limit is off.
NIBP	■ The NIBP audio alarm is on. ■ Each of the NIBP high/low limits is set to a value.	■ Maternal alarms cannot be turned off.
MHR/P	■ The MHR/P audio alarm is on. ■ Each of the MHR/P high/low limits is set to a value.	■ Maternal alarms cannot be turned off.
$MSpO_2$	■ The $MSpO_2$ audio alarm is on. ■ Each of the $MSpO_2$ high/low limits is set to a value.	■ Maternal alarms cannot be turned off.

Maternal Alarm Occurring During Setup

Alarm Behavior

If the visual indication of a maternal alarm is inhibited by a setup screen, only an audio alarm (if enabled) is issued. As soon as you exit the setup screen, the visual alarm indication displays.

- Example: If the *NIBP Setup* screen is displayed, the primary labor parameters continue to be displayed as well as the maternal *NIBP* area of the screen. Under an alarm condition that affects NIBP, both a visual and audible alarm is issued. Under an alarm condition that affects $MSpO_2$ or MECG, only an audio alarm (if enabled) is issued while the *NIBP Setup* screen remains displayed. Once the setup screen is exited, the visual alarm indication for $MSpO_2$ or MECG displays.

Fetal Heart Rate Alarms

FHR Patient Alarms

A fetal heart rate *patient* alarm occurs when any fetal heart rate falls outside of the pre-defined alarm limits—greater than the high limit setting or less than the low limit setting.

The FHR alarm function can be completely disabled from the password-protected *Install Options* service screen. For this change to take effect, you must cycle power. Refer to the "250/250cx Series Monitor Service Manual" for more information.

NOTE: The re-alarm time does not apply to FHR alarms—only MECG and $MSpO_2$ alarms. FHR values are not configurable.

Active Patient Alarm

A patient alarm is indicated both visually and audibly. The visual indication is provided by flashing the affected FHR numeric. The audio alarm consists of alternating high/low tones.

Resolved Patient Alarm

Resolved FHR alarms function differently than other alarms with a 250cx Series Monitor:

- **Resolved, Unsilenced FHR Patient Alarm:** You must acknowledge an FHR patient alarm—even if the condition has already been resolved. The visual and audible indications remain present until you press the **Alarm Silence** button. This ensures that a clinician is aware that an alarm occurred. You may hear this type of alarm described as *latching.*
- **Resolved, Silenced FHR Patient Alarm:** If you have already silenced an FHR patient alarm, the visual indications disappear automatically.

By comparison, the visual and audible indications for a *maternal* patient alarm automatically disappear as soon as the condition is resolved—whether or not you have acknowledged the alarm.

FHR Signal Quality Alarms

A fetal heart rate signal quality alarm occurs if the monitor is unable to detect an acceptable FHR signal.

Active Signal Quality Alarm

A signal quality alarm is indicated both visually and audibly. The visual indication is provided by flashing the FHR numeric (if available) or flashing dashes "– – –" in place of the FHR numeric. The audio alarm consists of alternating high/low tones.

Resolved Signal Quality Alarm

Resolved signal quality alarms function like most other 250cx Series alarms. As soon as an alarm condition is resolved, both the visual and audible indications automatically disappear.

Silencing an FHR Audio Alarm

Press the **Alarm Silence** button to cancel the audio; however, the visual indication remains until the condition is resolved.

Maternal Alarms

Maternal Patient Alarms

A maternal patient alarm occurs when a parameter value falls outside of the pre-defined alarm limits—greater than the high limit setting or less than the low limit setting.

- For MHR/P, the value used for analysis comes from the selected MHR/P source.

For Ohmeda and Masimo $MSpO_2$, the value must be out of range for 8 seconds. For Nellcor $MSpO_2$, the range depends upon the *SatSeconds* setting. Refer to *SatSeconds* in the “Maternal Pulse Oximetry Monitoring” Section for more information.

Active Patient Alarm

A patient alarm is indicated both visually and audibly. The visual indication is provided by flashing the associated numeric. The audio alarm consists of alternating high/low tones.

For $MSpO_2$, the MSpO2 value and accompanying pulse rate are printed on the strip chart paper.

Resolved Patient Alarm

The visual and audible indications automatically disappear as soon as the condition is resolved.

Signal Quality Alarms

If the monitor is unable to detect an acceptable signal, a signal quality alarm is provided.

Active Signal Quality Alarm

The following signal quality alarms are indicated both visually and audibly. The audio alarm consists of alternating high/low tones. The visual indication varies according to the alarm:

- **Asystole:** Dashes "– – –" display in place of the MHR/P numeric.
- **MECG Leads Off:** Dashes "– – –" display in place of the MHR/P numeric. The following message displays in the MHR/P area: *MECG LEADS OFF*. During this type of alarm, the MHR/P source automatically switches to the next available parameter ($MSpO_2$ then NIBP). As soon as the alarm condition is resolved and the MECG signal is detected, and the monitor resumes using MECG as the MHR/P source.
- **NIBP System Problem:** When there is a malfunction with the NIBP parameter, cuff, or air hoses, the monitor will be unable to make a determination. During this type of alarm, one of the following messages displays in the *NIBP* area: *CHECK CUFF*, *OVERPRESSURE*, *COMM*, *MOTION*, *WEAK SIGNAL*, or *REPAIR*. Refer to Chapter 16, "Troubleshooting", for more information on these messages.
- **$MSpO_2$ System Problem:** When there is a malfunction with the monitor's built-in $MSpO_2$ parameter, one of the following messages displays in the *$MSpO_2$* area: *COMM*, *REPAIR* or *SENSOR* (Nellcor only). Refer to Chapter 16, "Troubleshooting", for more information.
- **$MSpO_2$ Disconnect:** An $MSpO_2$ disconnect alarm occurs if: the $MSpO_2$ intermediate cable is disconnected from the monitor, the sensor assembly is disconnected from the intermediate cable, or the sensor or cable have a broken wire. Dashes "– – –" display in place of the $MSpO_2$ numeric.

Resolved Signal Quality Alarm

Resolved signal quality alarms behave like most other 250cx Series alarms. As soon as an alarm condition is resolved, the visual and audible indications automatically disappear.

Silencing a Maternal Audio Alarm

Press the **Alarm Silence** button to cancel the audio; however, the visual indication remains until the condition is resolved.

For MECG and $MSpO_2$, you can only *temporarily* silence the audio portion of the alarm. If the alarm condition remains, after expiration of the re-alarm time configured on the Master Alarm Setup screen, the audio alarm is re-issued.

Alarms Summary

Summary of 250cx Series Alarms			
Type	Condition	Display Message	Audible Notification
FHR	An alarm setting (audio or high/low limit) is turned off. Alarm Defaults Audio: on Volume: 5 Limits: High = 160 bpm, Low = 120 bpm	displays to the left of the FHR mode title.	—
	FHR limit (high or low) actively being violated. or Unsilenced, resolved FHR limit violation (the limit was violated but the FHR has since returned to the normal range before clinical acknowledgement). For continuous limit violations: a high alarm activates after 5 minutes; a low alarm activates after 30 seconds. About Latching Alarms: The FHR limit alarms are latching alarms which means that a clinician must acknowledge the alarm using the monitor's **Alarm Silence** button in order to clear the alarm.	FHR numeric flashes.	Alternating high/low tones (if audio enabled).
	Inadequate FHR signal quality.	Flashing dashes "– – –" in place of FHR numeric.	Alternating high/low tones (if audio enabled).
NIBP	Systolic, diastolic, or MAP pressure value (high or low) actively being violated.	NIBP numeric (systolic, diastolic, or MAP) flashes.	Alternating high/low tones (if audio enabled).
	Malfunction with NIBP circuitry, cuff, or air hoses.	*CHECK CUFF*, *COMM, MOTION*, *WEAK SIGNAL*, or *REPAIR* message displays in *NIBP* area.	Alternating high/low tones (if audio enabled).

Summary of 250cx Series Alarms			
Type	Condition	Display Message	Audible Notification
MHR/Pa[a]	MHR/P limit (high or low) actively being violated. The tachycardia response time is < 8 seconds.	MHR/P numeric flashes.	Alternating high/low tones (if audio enabled).
	Asystole.	Flashing dashes "– – –" in place of MHR/P numeric.	Alternating high/low tones (if audio enabled).
	MECG leads off.	Flashing dashes "– – –" in place of MHR/P numeric and *MECG LEADS OFF* message displays underneath.	Alternating high/low tones (if audio enabled).
$MSpO_2$[b]	$MSPO_2$ limit (high or low) actively being violated. Issued after about 8 seconds.	$MSpO_2$ numeric flashes. $MSpO_2$ value and pulse rate print on the strip chart.	Alternating high/low tones (if audio enabled).
	Malfunction with $MSpO_2$ circuitry.	*COMM* or *REPAIR* message displays in *$MSpO_2$* area.	Alternating high/low tones (if audio enabled).
	$MSpO_2$ intermediate cable disconnected from monitor, sensor assembly disconnected from intermediate cable, or sensor or cable has a broken wire.	Dashes "– – –" in place of $MSpO_2$ numeric.	Alternating high/low tones (if audio enabled).

[a]There is an MECG re-alarm.

[b]There is an $MSpO_2$ re-alarm.

11 Recorder Modes

For your notes

Modes

The 250cx Series Monitor has three recorder modes: off, on, and maternal-only. Factory default is ON.

Off Mode

When the recorder is off, the yellow Record indicator is off and nothing is *automatically* printed on the strip chart paper.

Even with the recorder turned off, it is possible to *manually* print the displayed waveform or the maternal vital signs history. Selecting the *Print* or *PrintAll* softkey places the recorder into a special high-speed printing mode. After the information is printed, the recorder turns off again. Refer to Chapter 12, “Maternal Vital Signs History” and Chapter 14, “Waveforms”, for more information.

On Mode

When the recorder is on, the yellow Record indicator continuously illuminates and the recorder runs at the selected speed of *1, 2,* or *3 cm/min.*

Maternal-Only Mode

What is the Maternal-Only Mode?

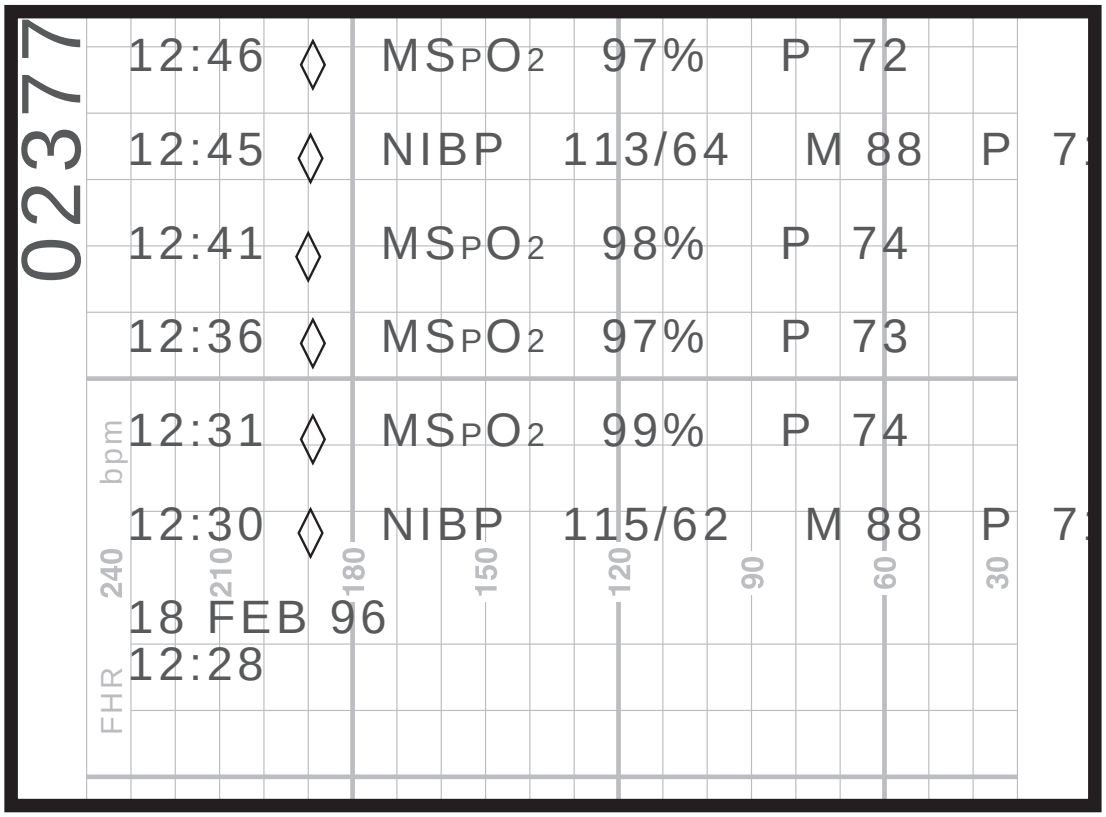
The maternal-only printing mode sets the recorder to a standby mode—turning the recorder on and off *as needed* to print information, such as:

- maternal non-invasive blood pressure;
- maternal pulse oximetry; and
- notes from a Model 2116B Clinical-Notes/Data-Entry System.

When the recorder is in the maternal-only mode, the yellow Record indicator flashes approximately every 5 seconds.

Printing Style

Information printed using the maternal-only mode prints vertically across the page. Figure on page 11-4 provides an example of a maternal-only mode printout.



Maternal-Only Mode Printout

A summary of the printed information follows:

- A blank line is printed after each message to improve readability.
- Each message can be a maximum of 40 characters in length.
- The time precedes each message.
- An outlined diamond marker (◊) indicates the data is provided by one of the monitor's *built-in* parameters.
- A filled diamond marker (⧫) indicates the data is provided by an *external* device interfaced to the monitor.
- The date is printed when the maternal-only mode is first activated, when the date/time is changed, and at midnight.

Changing Recorder Modes

Use the **Record** button to select between on, maternal-only mode, and off. Turn the recorder *on* for continuous trending; set the recorder to *maternal-only mode* when you are interested in the maternal vital signs, except MECG heart rate.

CAUTION
DATA STORAGE—Stored maternal vital signs history data is erased when you turn the *monitor off*. Therefore, for intermittent monitoring, it is recommended that you leave the *monitor on*, but turn the *recorder off*. Refer to Chapter 12, "Maternal Vital Signs History" for more information.

Changing Recorder Modes		
From	To	Button
Off	On	Briefly press once; or press and hold 3 seconds.
Off	Maternal-Only	Briefly press twice.
On	Maternal-Only	Briefly press once.
On	Off	Press and hold 3 seconds.[1]
Maternal-Only	On	Briefly press once.
Maternal-Only	Off	Press and hold 3 seconds.[1]
[1] A confirmation tone sounds to indicate the recorder has been turned off.		

Recorder Mode Audiovisual Indicator Status		
Recorder Mode	Record Indicator	Audio Indicator
On	continuously illuminated	Off
Maternal-Only	lights three short flashes every 5 seconds	
Off	Off	

Functionality with a QS System

Users of a Quantitative Sentinel (QS) System (Software Version 4.0.3.0 or earlier) should be aware of the following items when using the monitor's maternal-only mode:

Paper Versus Electronic Strip Charts

As described earlier, the monitor's maternal-only mode acts as a "paper saver" turning the strip chart recorder on and off as needed. However, the QS System overrides the maternal-only mode by storing the entire patient record. In other words, the *electronic* strip chart is retained as if the monitor's recorder were left on

continuously with all data lines printing in the annotation area; this may result in many blank pages in-between maternal vital signs data. In addition, the FHR mode will list *INOP*. Contact your Service Representative for clarification on your QS System's wiring.

Fetal Heart Rate Alarms

The QS System is designed to alarm when there is no fetal heart rate signal so it is recommended that you unplug the ultrasound and/or FECG transducers from the monitor, when not in use, to eliminate false alarms.

Trends

Multiple Trends

Multiple trends can be simultaneously printed on the strip chart paper. The Table below provides a summary of the different trend types; Figure on page 11-7 provides an example of a strip chart with five traces printed simultaneously.

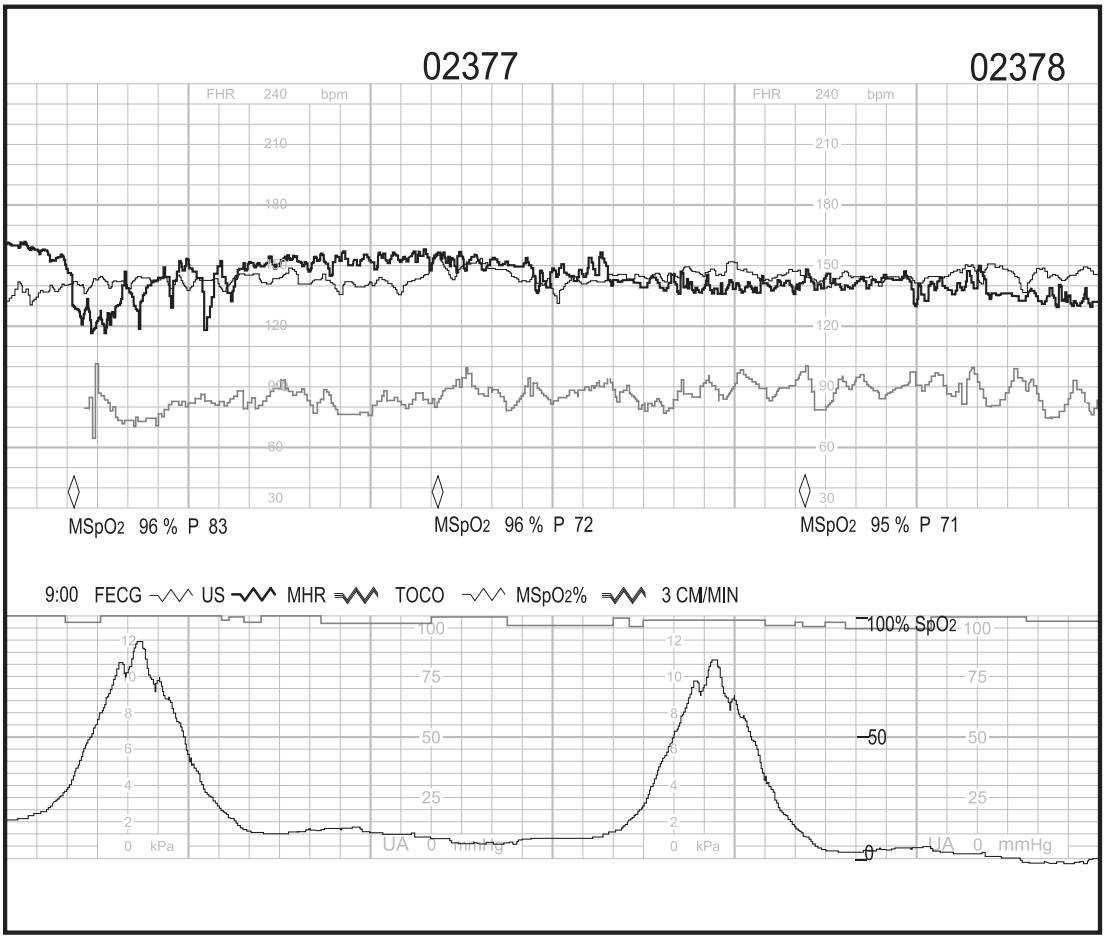
Up to three heart/pulse rate trends can be printed in the top (or left) channel of the strip chart paper: two FHR trends as well as the MHR/P trend. The primary FHR trend is printed in plain black. The secondary FHR trend is printed in bold black. The MHR/P trend is printed in grey.

The UA, External $FSpO_2$, and $MSpO_2$ trends are printed in the bottom (or right) grid of the strip chart paper. The UA trend is printed in plain black. The External $FSpO_2$ trend is printed as a black beaded line. The $MSpO_2$ trend is printed in grey.

The FHR and UA trends are printed continuously. The MHR/P, External $FSpO_2$, and $MSpO_2$ trends must all be enabled via the respective setup screen.

Summary of Strip Chart Trends

Grid	Source Type	Trace Description	Parameter	Trend Source
Top	Fetal	Plain Black	FHR1	*US or FECG*
		Bold Black	FHR2	*US or US2*
	Maternal	Grey	MHR/P	*MECG or $MSpO_2P$*
Bottom	External Fetal	Plain Black	$FSpO_2$	*External $FSpO_2$*
	Maternal	Plain Black	UA	*TOCO or IUP*
		Grey	$MSpO_2$	*$MSpO_2$*



Five Trends Printing Simultaneously

SpO_2 Scale

Two scale options are available for printing the $MSpO_2$ trends. The scale is printed on the paper along with the trend. This option is located in the password-protected *Install Options* screen.

- *Auto*: The trend plots on an expanded scale of 60–100% or 50–100%, depending on the paper.[2]
- *0–100%:* This option configures the $MSpO_2$ trend to always plot at a fixed scale of 0–100%.

Annotations

Several standard annotations are printed by the monitor to help analyze the strip chart data and complete the patient record. Most annotations print in the area between the top and bottom grids of the strip chart paper; however, some annotations print in either grid. All annotations are listed and explained in the "Summary of Annotations" Table.

[2]The $MSpO_2$ trend is plotted over a range of 60-100% on paper with a HR scale ranging from 30-240 bpm. The $MSpO_2$ trend is plotted over a range of 50-100% on paper with a HR scale ranging from 50-210 bpm.

Standard Annotations

The most common of the annotations which print on the *bottom* line are:

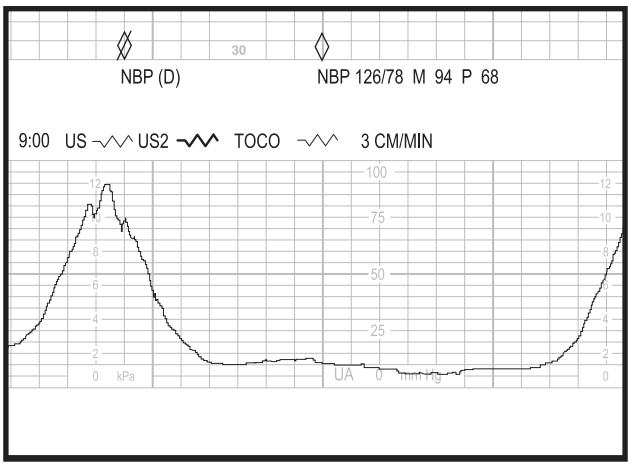
- date
- time
- active modes
- heart rate coincidence enable status
- fetal heart rate alarm enable status
- recorder speed
- telemetry status

Blood Pressure Annotations

A blood pressure reading can print on any of the first three annotation lines—depending on which printing line is available. A diamond marks the time of the reading.

- ◊: An unfilled diamond indicates the reading was received from the monitor's built-in blood pressure parameter. The vital signs print below the diamond. See Figure on page 11-8.
- ⊘: An unfilled diamond with a slash indicates a blood pressure reading was cancelled/delayed. The ⊘ marks the time the reading was originally scheduled. The annotation *NIBP (D)* prints below the marker. See Figure on page 11-8.
- ⧫: A filled diamond indicates the reading was received from an external blood pressure monitor connected to the 250cx Series Monitor. The vital signs print below the diamond. (Contact your Service Representative for connectivity information.)

If the top three printing lines are busy printing other data, the diamond prints at the time of the reading; however, the vital signs data prints as soon as a line becomes available.



NIBP Vital Signs Data Annotation from Built-In Module

Maternal Pulse Oximetry Annotations

A maternal pulse oximetry reading prints according to the interval time set on the *MSpO$_2$ Setup* screen (for built-in parameter) or the *General Setup* screen (for external device). For the built-in parameter, a reading also prints for each alarm generated. The reading can print on any of the first three annotation lines—depending on which printing line is available. A diamond marks the time of the reading.

- ◊: An unfilled diamond indicates the reading was received from the monitor's built-in maternal pulse oximetry parameter. The vital signs print below the diamond.
- ⧫: A filled diamond indicates the reading was received from an external maternal pulse oximeter connected to the 250cx Series Monitor. The vital signs print below the diamond. (Contact your Service Representative for connectivity information.)

If the top three printing lines are busy printing other data, the diamond prints at the time of the reading; however, the vital signs data prints as soon as a line becomes available.

The pulse rate value determined by MSpO2 always prints along with MSpO2.

Annotations from a Central Information System

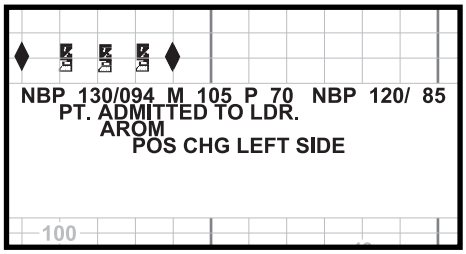
The 250cx Series Monitor has three built-in RS-232C ports which can be used to connect to a central information system which supports Hewlett Packard's Digital Series Protocol. Contact your Service Representative for more information.

The 250cx Series Monitor can also be configured via a communications service screen to print annotations received from a central information system. A computer marker prints on the bottom two lines of the heart rate grid marking the time the annotation was made from a remote location if the central station has the capability to send that command. See Figure on page 11-10.

Multiple Annotations

Sometimes annotations occur within seconds of each other. Consider the following example shown in Figure on page 11-10:

- an automatic NIBP reading occurs at 16:51:30
- three annotations are received from a central information system; the entries are made between 16:51:40 and 16:52:00
- a manual NIBP reading occurs at 16:52:10



Multiple Annotations Example

Summary of Annotations

Summary of Annotations	
Annotation	Explanation
Time and *Date* (Example: *10:40 12 AUG 97*)	Time and date are both printed on the bottom annotation line 20 seconds after the recorder is turned on and when the date changes after midnight. A time stamp automatically prints approximately every 10 minutes—at the 10-minute mark. For example: *10:50, 11:00, 11:10, 11:20, 11:30,* etc. If the bottom annotation line is being used to print another annotation, the time stamp is delayed. For example: *10:50, 11:00, 11:12, 11:20, 11:30,* etc. In this example, the *11:10* date stamp was delayed until *11:12.* The time and/or date also prints whenever it is changed via the *General Setup* screen.
SET TIME/DATE	If the monitor senses a clock circuit fault, when the recorder is turned on, this message replaces the normal time/date stamp. The message reprints every 10 minutes, at the 10-minute mark, until the clock is reset.
TEST: ARE ALL DOTS PRINTED?	This annotation prints across the width of the top strip chart grid when you press the Test button. The message reminds you to check for a continuous unbroken line of recorder dots.
	This icons prints prior to the FHR trend source annotations if the FHR alarms are enabled. The FHR alarm option is enabled/disabled via the password-protected *Install Options* service screen.
US or *FECG*	The trend source prints on the bottom annotation line by the following rules: ■ All trend sources print 20 seconds after the recorder is turned on, including inoperative modes. ■ All trend sources print every 30 minutes. ■ If a mode change occurs, only those trend sources belonging to the corresponding group print. If any top grid trend source changes, all top grid active trend sources are printed. If the UA mode changes, the active UA trend source is printed. A mode change is defined as: switching connectors; connecting to a front panel receptacle; disconnecting from a front panel receptacle; or enabling/disabling a trend on a setup menu.
US or *US2*	
MECG or MSpO$_2$P	
UA	
External FSpO$_2$	

Summary of Annotations (Continued)	
Annotation	Explanation
CARDIO INOP	This annotation prints in place of any trend source if the respective connector (FECG/MECG, US, or US2) is unused.
UA INOP	This annotation prints in place of the trend source if the UA receptacle is unused.
$MSpO_2$ INOP	This annotation prints if the trend is enabled and the Maternal SpO_2 receptacle is unused.
Chart Speed (Example: *3 cm/min)*	The chart speed prints on the bottom annotation line 20 seconds after you turn on the monitor.
UA REF	This message prints on the bottom line of the bottom strip chart paper grid during active uterine activity monitoring whenever: ■ you press the UA Reference button; or ■ whenever automatic re-zeroing occurs during tocotransducer monitoring.
BASELINE PRESSURE OFFSCALE	This annotation prints on the bottom line of the bottom strip chart paper grid during IUPC monitoring when the pressure falls below 0 mmHg for more than 20 seconds.
Maternal NIBP vital signs data. For example: ◊ *NIBP 103/ 71 M 83 P 72* (mmHg mode) *NIBP 13.7/9.5 M 11.1 P 72 (*kPa mode) or ⧫ *NIBP 103/ 71 M 83 P 72* (mmHg mode) *NIBP 13.7/9.5 M 11.1 P 72 (*kPa mode)	Maternal NIBP vital signs data prints for each manual and automatic determination. ■ ◊ identifies the 250cx Series as the source. ■ ⧫ identifies an external device as the source. The diamond prints on the bottom two lines of the bottom grid of the strip chart paper and marks the time of the reading. The vital signs data prints in one of the top three lines of the annotation area as soon as a printing line is available. The printed pulse rate value is derived from the blood pressure parameter and is independent of the MHR/P source selected on the *MHR/P Setup* screen.
⧰ *NIBP (D)*	Indicates an NIBP determination was cancelled or delayed due to the occurrence of a uterine contraction.
$MSpO_2$ vital signs data. For example: ◊ *$MSpO_2$ 97% P 66* or ⧫ *$MSpO_2$ 98% P 70*	$MSpO_2$ vital signs data is printed at selected intervals according to the *$MSpO_2$ Setup* screen (built-in parameter) or the *General Setup* screen (external device). In addition, *for the built-in parameter only*, vital signs data is printed when a $MSpO_2$ alarm occurs; however, only one alarm-related print occurs within a 5-minute period. ■ ◊ identifies the 250cx Series as the source. ■ ⧫ identifies an external device as the source. The diamond prints on the bottom two lines of the bottom grid of the strip chart paper and marks the time of the reading. The vital signs data prints in one of the top three lines of the annotation area as soon as a printing line is available. The printed pulse rate value is derived from the pulse oximetry parameter/monitor and is independent of the MHR/P source selected on the maternal *MHR/P Setup* screen.

Summary of Annotations (Continued)	
Annotation	Explanation
Remote annotation from a central information system. For example: *EPIDURAL GIVEN.* *AROM.* *POS CHG LEFT SIDE.*	This annotation represents notes received from a remote central information system. The computer icon prints in the bottom two lines of the top grid. The icon marks the time of the annotation and also indicates that the information comes from a remote computer such as a QS/Perinatal System. The notes print on any lines except the first, (The first line is reserved from NIBP vital signs data.)
HBC	This annotation prints on the first annotation line following the active heart rate mode(s) indicating heartbeat coincidence is enabled. This feature is enabled/ disabled via the password-protected *Install Options* service screen. The annotation represents only that the feature is enabled; it does not indicate that heartbeat coincidence has been detected.
♡♡	This annotation prints in the top two lines of the upper grid indicating that the monitor detects heartbeat coincidence.
♡♡	This annotation prints in the top two lines of the upper grid indicating the cessation of heartbeat coincidence.
	This annotation prints on the bottom two lines of the upper grid indicating that active telemetry signals are being received. The annotation re-prints every 30 minutes along with the modes.
	This annotation prints on the bottom two lines of the upper grid indicating that telemetry signals are no longer being received.
US + 20 or US2+20 → ← | | | | | | | | → ←	This annotation can only be seen when dual heart rate monitoring is in progress. The offset annotation US + 20 or US2+20 prints at the top of the upper grid indicating that the secondary fetal heart rate trend is shifted +20 bpm. The right/ left arrows (→ ←)and vertical dashed lines bracketing the heart rate grid indicate the start/end of the fetal heart rate offset mode, respectively.
↑	This annotation prints on the bottom two lines of the upper grid indicating an event. Generate the mark by one of the following: ■ Briefly press the monitor's Mark [Offset] button. ■ Press the FM Remote Marker button. (The Remote Marker is an accessory that can be connected to the 250cx Series Monitor. The monitor can be configured to use this arrow annotation or the one shown in the next row of this table. Refer to the "250/250cx Series Monitor Service Manual".)

Summary of Annotations (Continued)	
Annotation	Explanation
FM	This annotation prints on the bottom two lines of the upper grid indicating that the mother perceives fetal movement. The arrow prints each time the mother presses the FM Remote Marker button. Note: A horizontal bar prints as a tail on the arrow for as long as the button is held down. (The Remote Marker is an accessory that can be connected to the 250cx Series Monitor. The monitor can be configured to use this annotation or the one shown in the previous row of this table. Refer to the "250/250cx Series Monitor Service Manual".)
♪	This annotation prints on the bottom two lines of the upper grid indicating that the Corometrics Model 146 Fetal Acoustic Stimulator is being used. The music symbol prints each time a clinician presses the button on the stimulator.
Freestyle annotations. For example: *PT. NAME: JANET STEVENS* *PT. ID#: 6535148* *PT. AGE: 18 DR. CARTER*	Entries typed using a Corometrics Model 2116B Data-Entry/Clinical Notes Keyboard print in the annotation area. (The Model 2116B is an optional device that can be connected to the 250cx Series Monitor.)

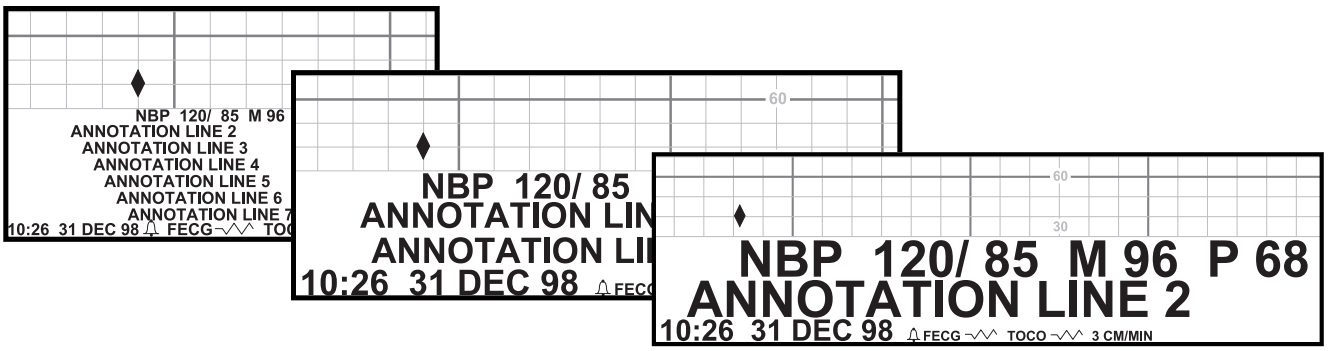
Adjustable Recorder Font Size

The 250cx Series Monitor offers a choice of font sizes to print annotations. (Refer to Table , "Summary of Annotations," on page 11-10.) A larger font size fosters readability; a smaller font size increases printing speed.

Set the font size on the password-protected *Install Options* service screen. Refer to the "250/250cx Series Monitor Service Manual" for more information.

CAUTION
FONT SIZE—If the medium or large font size is selected, there is the possibility that messages may be truncated during periods of multiple annotations.

Summary of Font Settings		
Font Setting	Printing Description	
	30–240 bpm Scale Paper	50–210 bpm Scale Paper
Small	■ Eight annotation lines are available. ■ Time/date, modes, and annotations all print using the small font size. ■ See Figure on page 11-14.	■ Four annotation lines are available. ■ Time/date, modes, and annotations all print using the small font size.
Medium	■ Four annotation lines are available. ■ Time/date and annotations print using the medium font size. ■ Modes print using the small font size. ■ See Figure on page 11-14.	■ Two annotation lines are available. ■ Time/date and annotations print using the medium font size. ■ Modes print using the small font size.
Large	■ Three annotation lines are available. ■ Annotation print using the large font size. ■ Time/date print using the medium font size. ■ Modes print using the small font size. ■ See Figure on page 11-14.	



Multiple Font Sizes

Chart Style Vital Signs Printing

The monitor provides an option for chart-style printing of blood pressure and $MSpO_2$ values on standard clock quarter, half, and whole hour marks.

Enabling/Disabling Chart-Style Printing

The chart-style feature is enabled/disabled from the password-protected *Install Options* service screen. Refer to the “Maternal/Fetal Monitoring, Clinical Applications Manual” for more information.

Examples of Printing Styles

Chart-Style Printing Examples

When chart-style printing is *enabled*:

- The 15-minute interval prints on the quarter hour (e.g., *9:00, 9:15, 9:30, 9:45,* etc.).
- The 30-minute interval prints on the half hour (e.g., *9:00, 9:30, 10:00, 10:30,* etc.).
- The 60-minute interval prints on the hour (e.g., *9:00, 10:00, 11:00, 12:00,* etc.).

The following are examples of chart-style printing:

- NIBP Example 1: The automatic blood pressure mode is activated at 9:03, with the interval time set to 15 minutes. Whereas the first *real-time* reading would occur at 9:18, the first *chart-style* reading is taken at 9:15. Subsequent readings are taken and printed at 9:30, 9:45, 10:00, 10:15, etc.
- NIBP Example 2: The automatic blood pressure mode is activated at 9:17, with the interval time set to 30 minutes. Whereas the first *real-time* reading would occur at 9:47, the first *chart-style* reading is taken at 9:30. Subsequent readings are taken and printed at 10:00, 10:30, 11:00, 11:30, etc.
- $MSpO_2$ Example 1: The $MSpO_2$ print interval time is set to 30 minutes and the sensor is connected at 9:24 a.m. Whereas the first *real-time* printing would occur at 9:54, the first *chart-style* printing is done at 9:30. Subsequent values are printed at 10:00, 10:30, 11:00, 11:30, etc.
- $MSpO_2$ Example 2: The $MSpO_2$ print interval time is set to 60 minutes and the sensor is connected at 9:42 a.m. Whereas the first *real-time* printing would occur at 10:42, the first *chart-style* printing is done at 10:00. Subsequent values are printed at 11:00, 12:00, 1:00, 2:00, etc.

Real-Time Printing Example

When chart-style printing is *disabled*, standard real-time printing occurs.

- NIBP Example: The automatic blood pressure mode is activated at 9:03, with the interval time set to 15 minutes. The first reading occurs at 9:18. Subsequent readings are taken at 9:33, 9:48, 10:03, etc.
- $MSpO_2$ Example: The print interval is set to 15 minutes and the first acceptable pulse signal is detected at 9:05 a.m. The first printing occurs at 9:05. Subsequent $MSpO_2$ values are printed at 9:20, 9:35. 9:50, 10:05, etc.

Chart-Style 7-Minute Exception for NIBP

If you take a manual blood pressure reading within 7 minutes of a chart-style interval (15, 30, or 60 minutes) *and then* activate automatic blood pressure readings using a chart-style interval, the first automatic reading will be skipped.

This rule only applies to *the first reading when chart-style vital signs printing is enabled* on the password-protected *Install Options* service screen.

- Example: You take a manual blood pressure reading at 7:10. At 7:13 you then activate automatic blood pressure readings using a 15-minute time interval. The 7:15 chart-style reading is skipped since a manual reading occurred 5-minutes earlier. The first automatic reading is taken at 7:30. Since the rule applies only to the first reading, if you take another manual reading at 7:40, the 7:45 automatic reading occurs as scheduled.

Strip Chart Paper

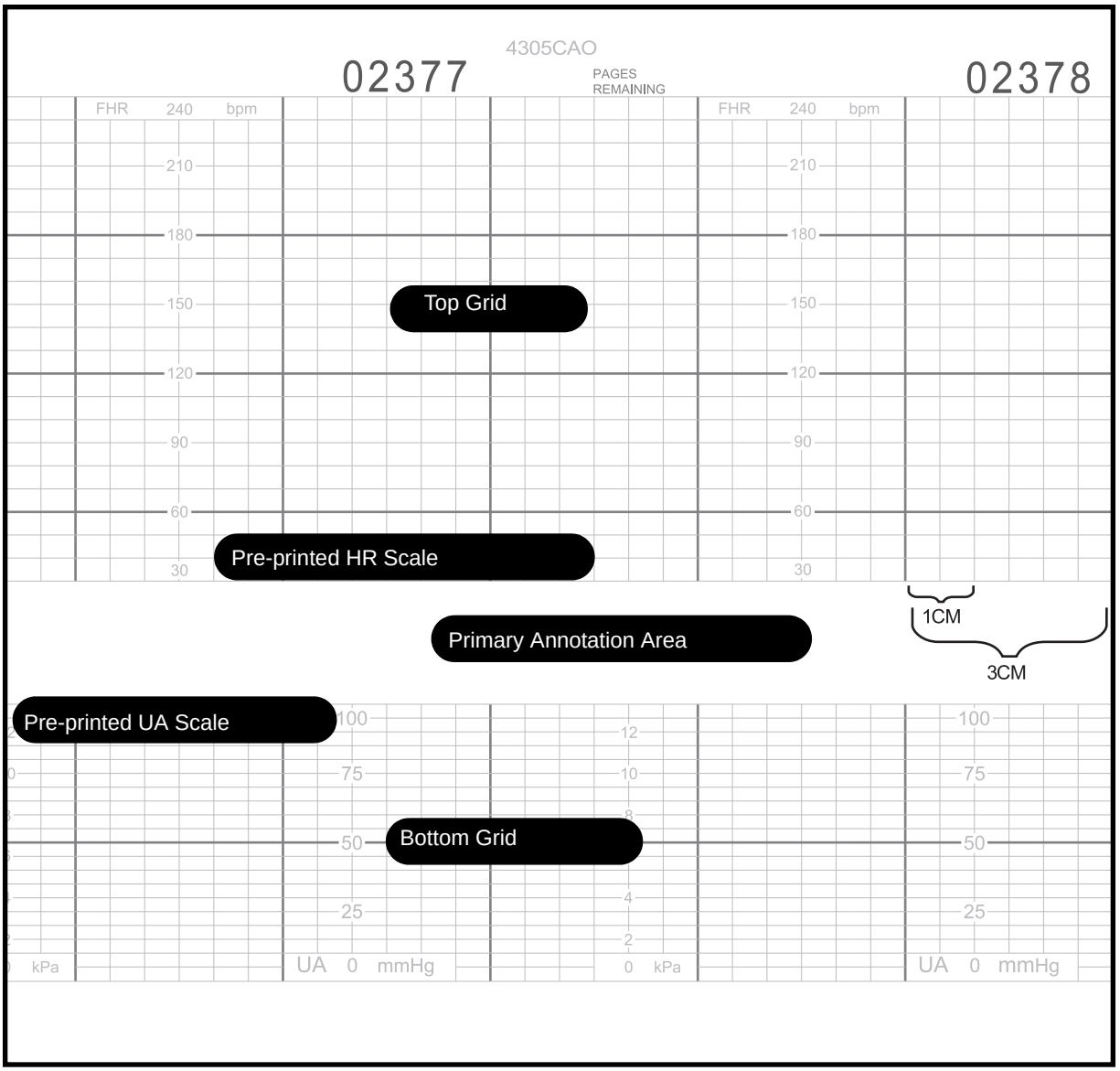
Instructions for loading the strip chart paper are provided in Chapter 4, “Setup Procedures”. Two kinds of strip chart paper are available from GE.

- Z-Fold Chart Paper with Pre-Printed **30–240** bpm Heart Rate Scale (Refer to Figure on Page 11-17.)
- Z-Fold Chart Paper with Pre-Printed **50–210** bpm Heart Rate Scale (Refer to Figure on Page 11-18.)

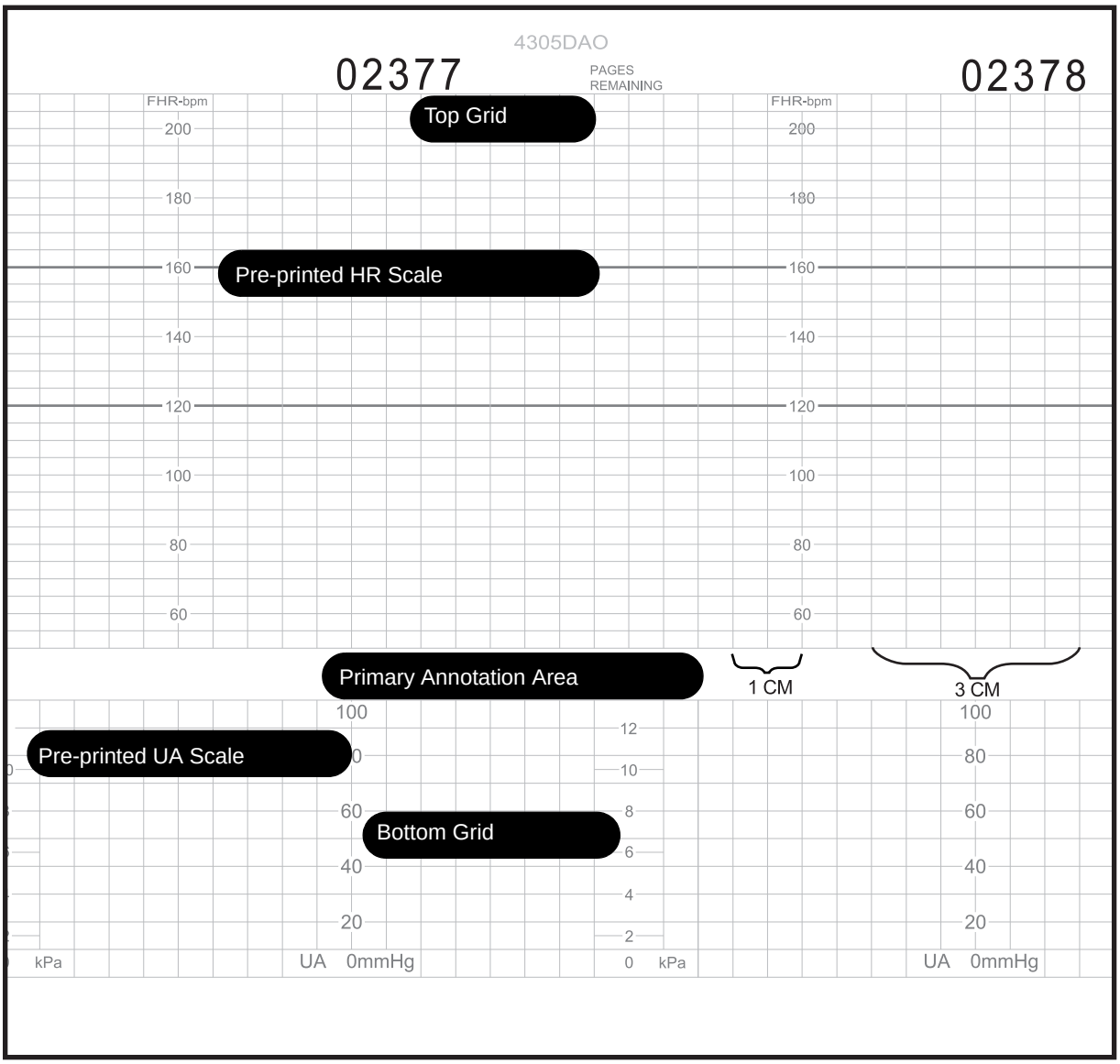
In the United States of America, the most common grid is the 30-240 bpm scale with the recorder speed set at 3 cm/min. As shown in Figure on Page 11-17, a dark line is printed every 3 cm, which represents 1 minute in time at a speed of 3 cm/min.

In other countries, the most common grid may be the 50–210 bpm scale with the recorder speed set at 1 cm/min. As shown in Figure on Page 11-18, every other vertical line measures 1 cm, or 1 minute in time at a speed of 1 cm/min.

Regardless of the heart rate scale, the uterine activity scale is pre-printed from 0–100 mmHg (0.0–13.3 kPa); this same scale is used for relative units. When SpO_2 and monitoring is in progress, the scale is printed on the paper by the recorder. The Figures on pages 12-3 and 12-4 also call out the top grid, bottom grid, and the annotation area for each style paper.



Strip Chart Paper with 30–240 bpm Heart Rate Scale



Strip Chart Paper with a 50–210 bpm Heart Rate Scale

PAPER-LOW, PAPER-OUT, and PAPER-LOADING Error Conditions

The 250cx Series Monitor alerts you when paper is running low or when the recorder is completely out of paper. To protect against paper jams, the recorder also contains a paper-loading sensor which notifies you if the paper has been incorrectly loaded. Refer to “Loading Strip Chart Recorder Paper” on page 4-3, and follow the instructions on loading paper into a 250cx Series Monitor.

The alarms are summarized by the following Table . The volume of the alarm tone for all three conditions is configured on the password-protected *Install Options Screen 1* screen.

Recorder Error Conditions				
Paper Error Condition	Record Indicator Status	Recorder Behavior	Audio Status	Alarm Silence Button Behavior
PAPER LOW Low/Out	Flashes on and off once every second.	Continues to print until paper runs out.	Two short tones every 30 seconds.[1]	Cancels the alarm.
PAPER OUT Out Only	Off	Automatically stops printing.	Three short tones every 30 seconds.[1]	Cancels the alarm.
PAPER INCORRECTLY LOADED	Flashes on and off once every second. The message *PAPER INCORRECTLY LOADED, RELOAD WITH BLACK SQUARES DOWN* displays in the waveform area of the display.	Does not print.	Three short tones every 3 seconds.	Temporarily silences alarm. The alarm is re-issued if the condition continues after the re-alarm time specified on the *Install Options Screen 2.*
[1] The paper chime audio is enabled on the password-protected *Install Options Screen 1*.				

12 Maternal Vital Signs History

For your notes

What is the Maternal Vital Signs History Screen?

This feature displays/prints maternal vital signs data in a spreadsheet format—called Vital Signs History. An example of the maternal Vital Signs Screen is shown on page 12-4. A printout example is shown on page 12-6.

CAUTION
DATA STORAGE—Stored data for history is immediately lost when the monitor is turned off.

This ensures that stored data for one patient is not inadvertently transferred to a new patient. It should be noted that the maternal Vital Signs History feature is most beneficial when a patient is being continuously monitored. If a patient is being monitored intermittently, all history data is erased each time the monitor is turned off.

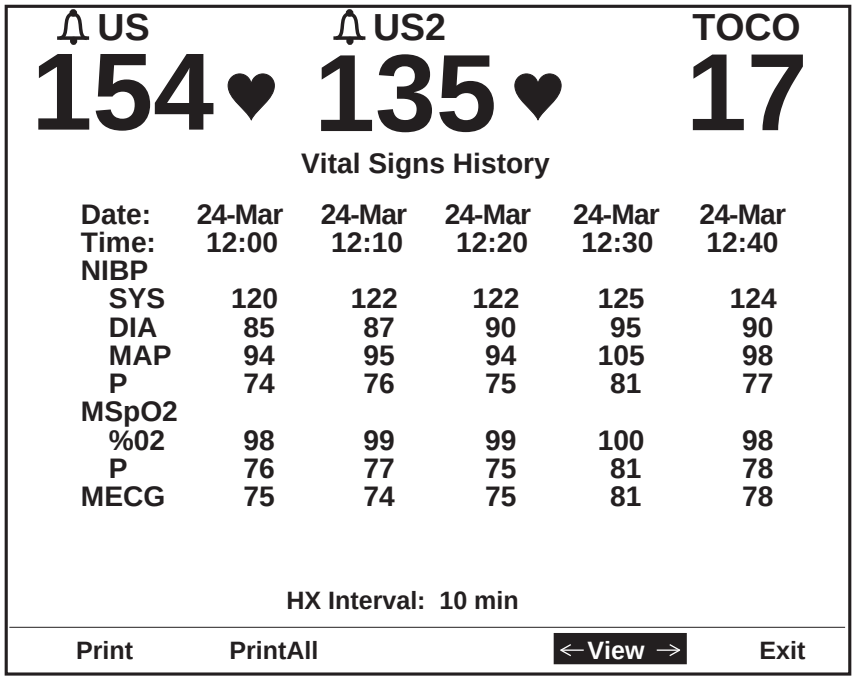
If a significant amount of history data has been collected and the monitor must be turned off, you may wish to print the data prior to powering off the monitor in order to retain a hard copy for your files.

The monitor stores up to 8 hours of data on a first-in, first-out basis —available for review and printing at any time. After 8 hours of data storage, the oldest data begins to be replaced by new data.

NOTE: The monitor stores blood pressure and maternal pulse oximetry events from the monitor's built-in parameters. The monitor only stores external device data from the TAT-5000 external temperature probe. See monitor service manual for proper communications settings to interface TAT-5000.

The monitor stores the following maternal vital signs data:

- *Each* manual and automatic blood pressure event is stored. A blood pressure event includes the systolic pressure, diastolic pressure, mean arterial pressure, and maternal pulse rate derived from the blood pressure cuff.
- An event snapshot of $MSpO_2$ is taken every minute. An $MSpO_2$ event includes the $MSpO_2$ and the maternal pulse rate derived from the sensor.
- An event snaphot of the MHR is taken every minute. An MHR event is the MHR value derived from the MECG electrodes.
- Manual temperature events initiated from the external TAT-5000 temperature probe.



NOTE: NIBP values appear in kPa when in kPa mode.

Maternal Vital Signs History Screen

Using the Maternal Vital Signs History Screen

Displaying the Screen

1. Select the *VSHX* softkey to display the *Vital Signs History* screen.
2. Select the ←*VIEW*→ softkey to scroll through the data. Scroll right roll towards the oldest data; scroll left towards the most recent data
3. Press the Trim Knob control to de-activate the ←*VIEW*→ softkey.
4. Select the *Exit* softkey to return to the main screen.

Selecting the HX Interval

The maternal *Vital Signs History* screen can be configured to *display* different columns of data by adjusting the *HX Interval* field. The interval choices are: *Event* (to display *all* events) and *1, 5, 10, 15, 30,* and *60* minutes. (The factory default setting is *Event*.)

The history interval has no effect on the data being stored. You can change the interval setting at any time and all data for the most recent 8 hours is available for display.

When the screen is called up for display, the previous minute in time is listed at the far right of the screen; the preceding values to be displayed are counted backwards from the previous minute in time, based on the intervals you have selected.

- Example: The *HX Interval* is set at 5 minutes and the maternal *Vital Signs History* screen is displayed when the current time is 13:57. When the screen is displayed there will be five columns of data for the following times:

  13:36 13:41 13:46 13:51 13:56

  If the screen remains displayed for 1 minute the columns of data change to:

  13:37 13:42 13:47 13:52 13:57

Printing the Maternal Vital Signs History Screen

NOTE: Once the print function is activated, you may exit the history screen; it need not remain displayed during printing.

You can select all or a portion of the maternal vital signs history for printing on the strip chart paper. The information is printed in the upper portion of the top (or left) grid of the strip chart paper at a high speed mode. If the recorder is on, all other trending is interrupted while the maternal vital signs history is printed. If the recorder is in the maternal-only mode, the recorder interrupts any printing of data to print the vital signs history; any pre-empted data is printed at the end. If the recorder is off, it will turn on to print the vital signs history, then turn off again.

Printing the Entire Vital Signs History

Select the *PrintAll* softkey to print the entire vital signs history. An audible tone provides confirmation.

Printing a Page of the Vital Signs History

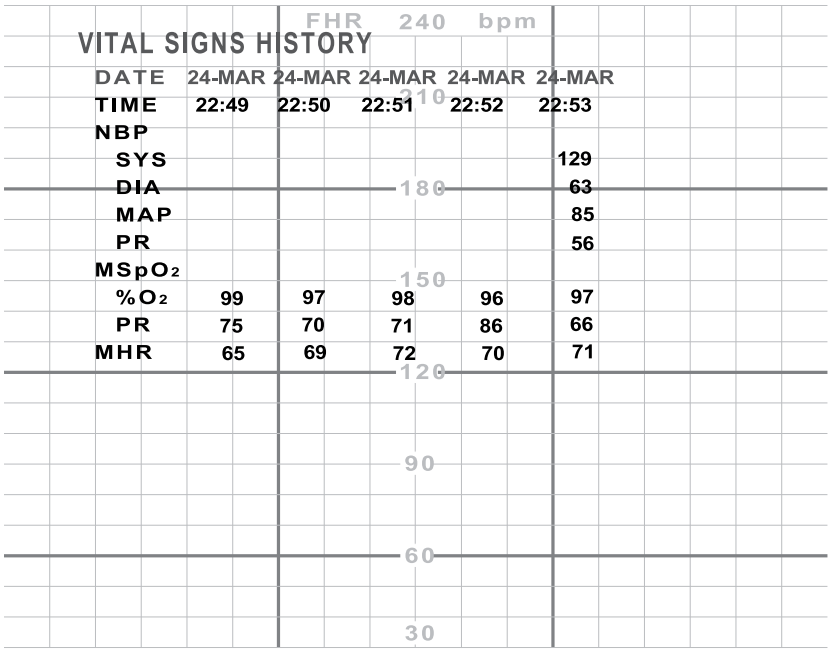
Use the ←*View*→ softkey to display a page; then select the *Print* softkey to print the selected page. An audible tone provides confirmation.

Stopping the Printing of Maternal Vital Signs History

Printing automatically stops if:

- you open the recorder door;
- strip chart paper runs out;
- you press the Test button;
- you change the recorder mode.

CAUTION
Do not turn monitor off during printing or your data will be lost.



Vital Signs History Print Example

13 Heartbeat Coincidence

For your notes

Heartbeat Coincidence Theory

The heartbeat coincidence feature alerts you when there is the possibility that you may be monitoring a duplicate signal. Heartbeat coincidence is indicated when any two heartbeats have a consistent phase relationship for equal to or greater than 60% of the detected beats for about 60 seconds; the cessation of coincidence is indicated when the phase relationship is inconsistent for greater than 40% of the detected beats for about 7 seconds.

Heartbeat coincidence detection is most useful when monitoring twins but can also detect when an elevated maternal heart rate is mistaken for a fetal heart rate.

NOTE: The maternal heart rate derived from blood pressure readings is not used to detect heartbeat coincidence since blood pressure is a static measurement.

The following table summarizes the combinations of heart rate sources that are continuously compared for the possibility of coincidence.

Heartbeat Coincidence Comparisons					
Mode	*FECG*	*US*	*US2*	*MECG*	*MSpO2*
FECG		🕑	🕑	🕑	🕑
US	🕑		🕑	🕑	🕑
US2	🕑	🕑		🕑	🕑
MECG	🕑	🕑	🕑		
$MSpO_2$	🕑	🕑	🕑		

Using the Heartbeat Coincidence Feature

Enabling/Disabling Heartbeat Coincidence Detection

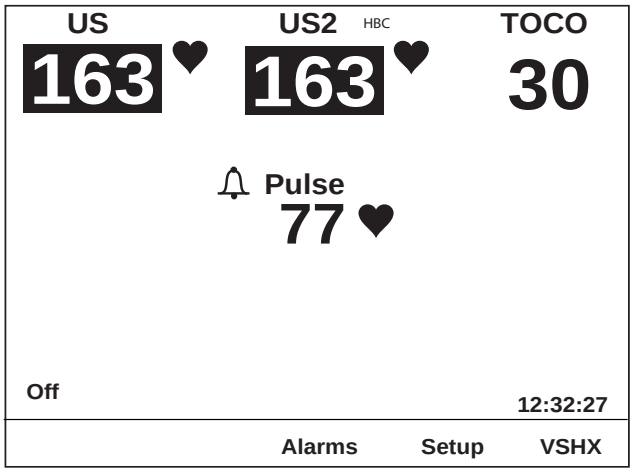
This feature is enabled from the password-protected *Install Options* service mode screen. Refer to the “250/250cx Series Monitor Service Manual” for detailed information about enabling/disabling this feature.

Display Indicator

When heartbeat coincidence detection is *enabled*, the acronym *HBC* appears to the right of the FHR2 mode title. (See “Heartbeat Coincidence Example” below.) If the monitor detects two heartbeats that appear to be coinciding, this may indicate that the two channels are picking up the same signal. When this coincidence occurs, the heart rate numerics for *both* heart rates display in inverse video, as shown below. (Inverse video is a dark background with white numerics.) As soon as coincidence is resolved, the numerics return to standard video. (Standard video is a white background with dark numerics.)

NOTE: Although an unlikely scenario, if three channels are picking up the same signal, the heart rate numerics for all three heart rates display in inverse video.

If you disconnect a transducer while coincidence is detected, any value displayed in inverse video returns to standard video.



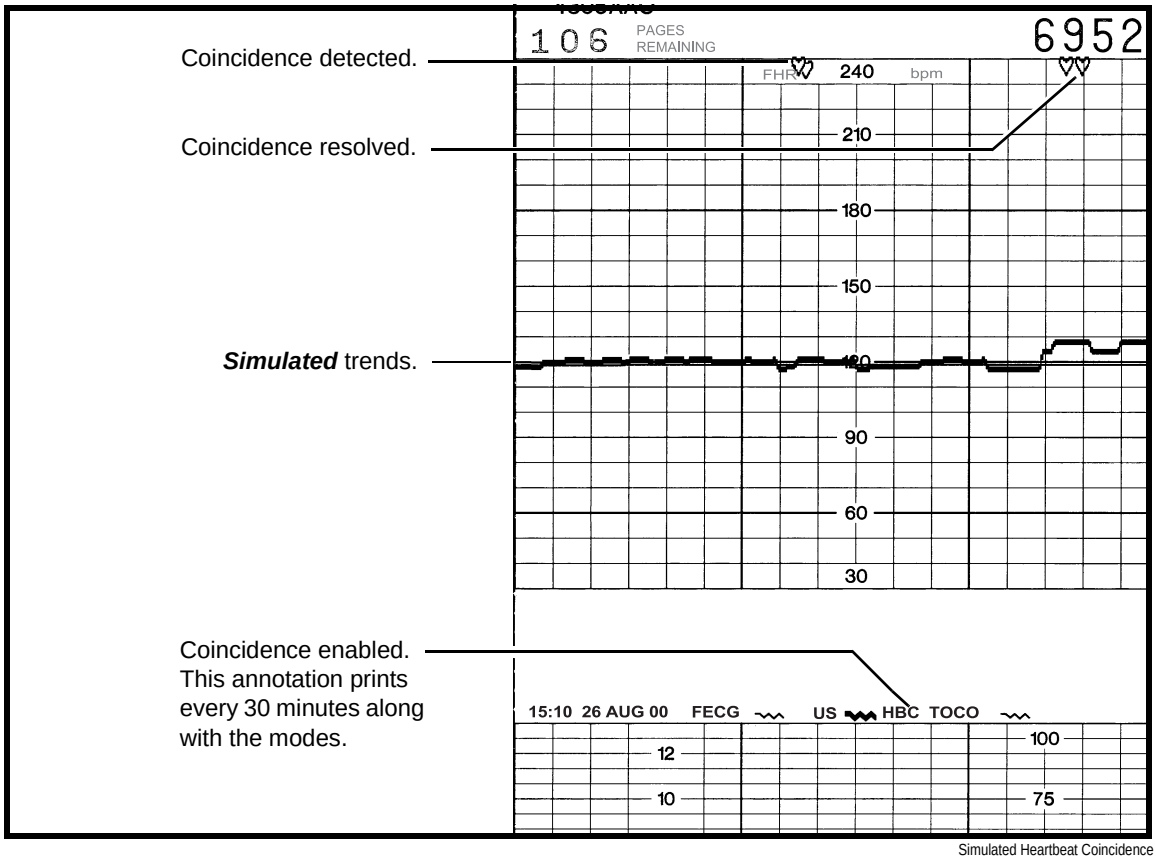
Heartbeat Coincidence Example

Strip Chart Annotation

When heartbeat coincidence detection is enabled, the annotation *HBC* prints in the center margin of the strip chart paper following the active FHR modes. (Refer to “Simulated Heartbeat Coincidence Detection Trace,” on page 13-5.)

As soon as heartbeat coincidence is detected, two overlaid hearts ♡♡ print in the upper portion of the top grid of the strip chart paper; the hearts print every 4.5 cm for as long a coincidence is detected. Once coincidence is resolved, two side-by-side hearts print ♡♡ once.

If you disconnect a transducer while coincidence is detected, the overlaid hearts ♡♡ stop printing. In addition, the mode status line prints on the strip chart paper—without the *HBC* annotation—indicating the deactivated mode.



Simulated Heartbeat Coincidence Detection Trace

14 Waveforms

For your notes

Waveform Area

The waveform area displays approximately 4 seconds of waveform data from one of the following: FECG, MECG, or $MSpO_2$. The waveform chosen for display is independent of any of the numerics shown on the display.

For example: $MSpO_2$ can be chosen as the maternal pulse rate source (numerics) while the MECG waveform is selected for display in the waveform area.

CAUTION
WAVEFORM INTERPRETATION—Waveforms generated by the 250cx Series Monitor are not intended for true diagnostic interpretation.

Selecting the Waveform

Use the Waveform softkey on the normal operating screen to select *FECG*, *MECG, MSpO2,* or *Off.* (Refer to Figure on page 14-4.)

Waveform Speed

All waveforms are displayed at a rate of 25mm/sec. This speed is not adjustable. The speed is displayed at the top right of the waveform.

ECG Size

The size is printed in the upper right above the waveform. This label is also a softkey which can be used to change the setting. Select from the following: *0.25x (4 mV/cm), 0.5x (2.0 mV/cm), 1x (1.0 mV/cm), 2x (0.5 mV/cm), 4x (0.25 mV/cm),* or *Auto*.

MECG Lead Select

The selected lead is displayed in the upper right above the waveform. This label is also a softkey which can be used to change the setting. Select from the following: *I, II,* or *III.*

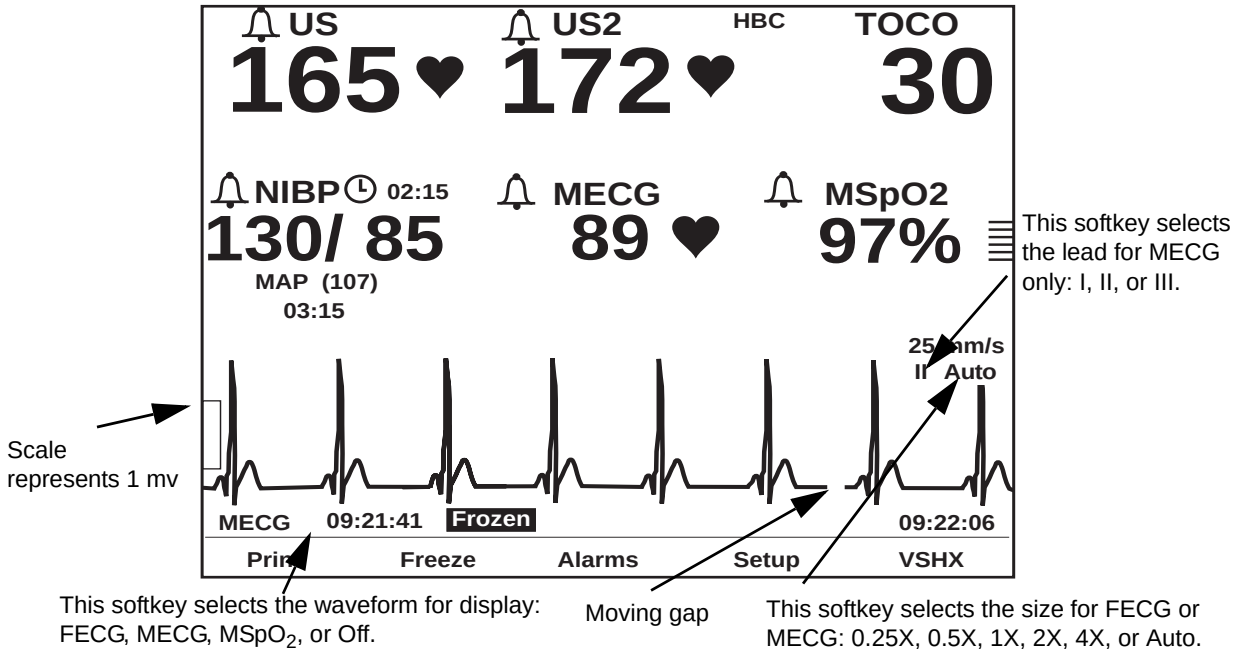
NOTE: The MECG lead can also be changed from the *MHR/P Setup* screen.

MECG Pacer Label

When the *MECG Pacer* option is enabled (*On*), the letter *P* is displayed prior to the waveform speed. See Figure on page 7-6.

Moving Gap

For all waveforms, a moving gap (a blank gap separating the line in a waveform) scrolls along the screen. The gap can be thought of as a pen drawing the waveform on the screen and erasing old data along the way. The most recent data is displayed to the left of the bar; the oldest data is displayed to the right of the bar.



Waveform Area on the Display

Freezing Waveforms

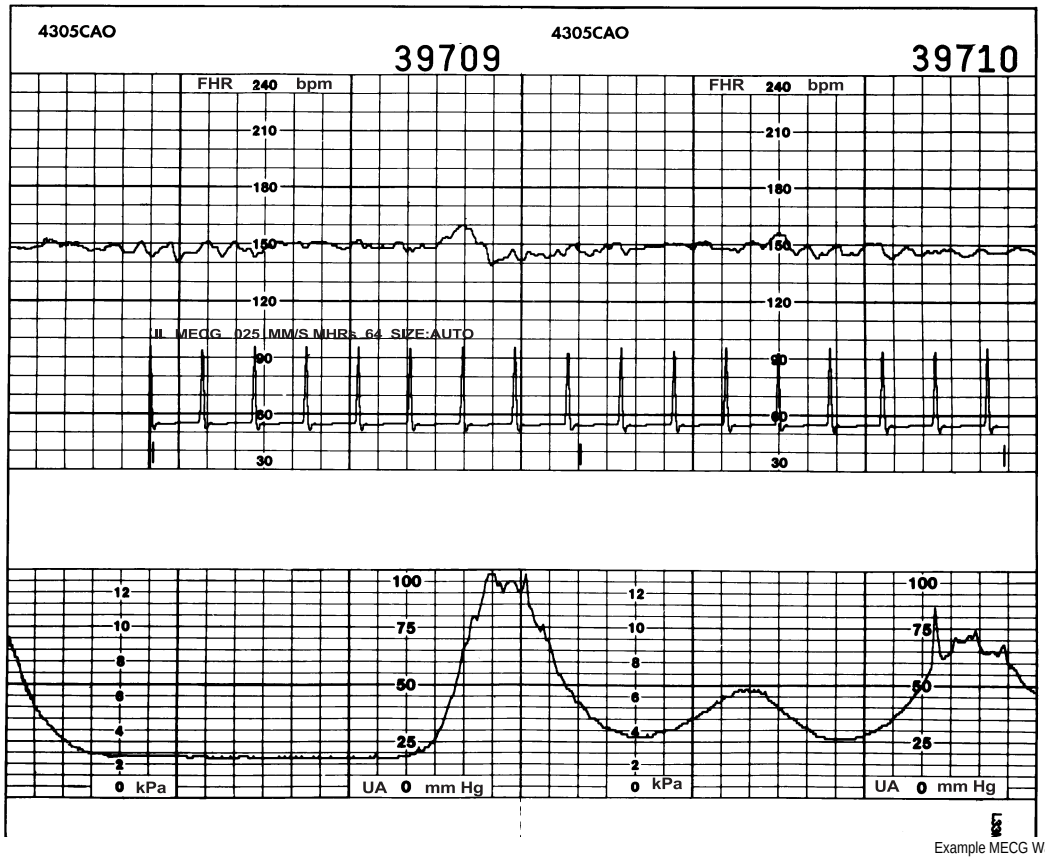
The waveform displayed in the waveform area can be “frozen” on the display for review; the most recent data is displayed on the screen for analysis. The message *Frozen* (for any waveform), along with the time of activation, is displayed at the lower left of the waveform. (All numerics continue to be updated and the real-time clock continues to be displayed.)

Select the *Freeze* softkey to freeze a waveform; select it again to return to real-time display.

Printing a Waveform Snapshot

Select the *Print* softkey to print a 6-second snapshot of the displayed waveform—regardless of whether the waveform real-time or frozen. The following figure provides a sample MECG waveform snapshot on strip chart paper.

The waveform is printed on the lower portion of the top (or left) grid. A vertical tick mark is printed at the start, 3-second mark, and end (or 6-second mark), for reference. If the waveform is *frozen*, 6 seconds of historical data are printed *ending* with the time the waveform was frozen on the display. If the waveform is displayed in *real-time*, 6 seconds of historical data are printed *ending* with the time the *Print* softkey was activated.



Example MECG Waveform Snapshot

Recorder On

If the recorder is on, the waveform overlaps the MHR/P trace (if enabled), with no interruption to other trending. The recorder speed remains at the selected rate of *1, 2,* or *3 cm/min.*

Recorder in Maternal-Only Mode

If the recorder is running in maternal-only mode, the waveform does not interrupt the printing of data and prints at a high-speed mode of 12 cm/min. When finished, the recorder returns to the maternal-only mode.

Recorder Off

If the recorder is off, the waveform print using a high-speed mode of 12 cm/min after which the recorder turns off again.

NOTE: You *cannot* switch between different types of waveforms without cancelling any printing that is in progress.

NOTE: The monitor must collect 6 seconds of *new* data following completion of a print function before it can print again.

Stopping a Print Command

The following actions interrupt waveform printing:

- changing the recorder mode
- pressing the Test button
- opening the recorder door
- running out of paper
- turning off the monitor

CAUTION
DATA STORAGE—Stored data for the maternal *Vital Signs History* screen is immediately lost when the monitor is turned off. This ensures that stored data for one patient is not inadvertently transferred to a new patient. Refer to Chapter 12, “Maternal Vital Signs History” for more information.

15 Maintenance

For your notes

Cleaning

General care and cleaning are required for the 250cx Series Monitor and its accessories. If an accessory is not listed, consult the manufacturer's instructions.

CAUTION
Unplug the monitor from the AC power source and detach all accessories from the monitor. Do not immerse accessories in any liquid. Do not use abrasive cloth or cleaners on monitor or accessories.

Monitor Exterior

1. The exterior surfaces of the equipment may be cleaned with a dampened, lint-free cloth. Use one of the following approved solutions:
   - Commercial diluted bleach solution
   - Mild soap (diluted)
   - Commercial diluted ammonia solution

   NOTE: Always dilute cleaning solutions per manufacturers' recommendations.
2. Wipe off cleaning solutions with a clean dry cloth.
3. Do not use a cleaning substance containing wax.
4. Do not pour or spray water or any cleaning solution on the equipment or permit fluids to run behind switches, into the connectors, into the recorder, or into any ventilation openings in the equipment.
5. Do not use the following cleaning agents:
   - Abrasive cleaners or solvents of any kind
   - Acetone
   - Ketone
   - Alcohol-based cleaning agents or
   - Betadine

CAUTION
Failure to follow these rules may melt, distort, or dull the finish of the case, blur lettering on the labels, or cause equipment failures. Cleaning products known to cause the types of problems mentioned above include, but are not limited to Sani-Cloth Wipes*, Sani-Wipes*, and Ascepti Wipes*. These should be avoided. Products containing active ingredients and solutions similar to these products should also be avoided.

Display

To clean the display screen, use a soft, clean cloth dampened with a glass cleaner. Do not spray the glass cleaner directly onto the display. Do not use alcohol or hospital disinfectants like Cidex* or Betadine.

Tocotransducer and Ultrasound Transducer

CAUTIONS

ABRASION—Do not use abrasive cloth, sharp objects, or abrasive cleaners.

ALCOHOL—Do not use Alcohol in cleaning solutions.

DISCONNECTION—Detach the transducers from the monitor.

NOTE: Only Nautilus transducers are immersible.

1. Dampen a cloth or paper towel with one of the following products; then wring out until only slightly wet:
   - Sodium Hypochlorite 5.25% (Bleach) diluted 10:1
   - Cidex*
   - Sporicidin*
   - Soap and water
2. Rub soiled area until clean, taking care not to excessively wet the tocotransducer diaphragm seal. Rub around the seal.
3. Dry with a soft, dry cloth.

Leg Plates and MECG Cables

CAUTIONS

ABRASION—Do not use abrasive cloth, sharp objects, or abrasive cleaners.

ALCOHOL—Do not use Alcohol in cleaning solutions.

DISCONNECTION—Detach the cables/legplate from the monitor.

IMMERSION—Do not immerse cables or hold under running water.

1. Dampen a cloth or paper towel with one of the following products; then wring out until only slightly wet:
   - Sodium Hypochlorite 5.25% (Bleach) diluted 10:1
   - Cidex*

*Trademarked

- Sporicidin* Soap and water

2. Rub soiled area until clean.
3. Dry with a soft, dry cloth.

Maternal NIBP Cuffs and Hoses

General

The cuff must be thoroughly cleaned with the specified detergent before reuse. The additional use of household bleach as described below provides at least intermediate-level disinfection.

- Apply cuff hose plugs before cleaning.
- The following cleansing procedure was repeated 20 times on DURA-CUF® Blood Pressure Cuffs and once on SOFT-CUF® Blood Pressure Cuffs without affecting the performance of the cuff.
- While this procedure is adequate for cleaning/disinfection, it may not remove all stains.
- Do ***not*** immerse hoses.
- Do ***not*** immerse cuffs without prior application of cuff hose caps.

Materials

- Enzymatic detergent such as ENZOL* enzymatic detergent (US) or Cidezyme* enzymatic detergent (UK)
- Distilled water
- 10% solution of household bleach (5.25% sodium hypochlorite) in distilled water
- Soft cloths and soft-bristled brushes
- Spray bottles

Procedure

1. Prepare the enzymatic detergent according to the manufacturer's instructions and the 10% bleach solution, in separate spray bottles.
2. Spray the detergent liberally on device. If the material is dried on, allow the cuff to sit for 1 minute. For soil on the soft part of the closure or the cuff itself, wipe the material off with a soft cloth. For persistent contamination on the soft part of the closure, use a soft-bristled brush to loosen particles. Rinse with copious amounts of distilled water. Repeat until no visible contamination remains. For soil on the hook part of the closure, use a soft-bristled brush to remove the material, and rinse with copious amounts of distilled water. Repeat until no visible contamination remains.
3. Spray the 10% bleach solution on the affected area until the area is saturated. Allow the cuff to sit for 5 minutes.
4. Wipe away any excess solution and rinse the cuff again with distilled water. Allow 2 hours for drying.

*Trademarked

The user has the responsibility to validate any deviations from the recommended method of cleaning and disinfection.

For additional information on infection control procedures, contact GE Medical Systems *Information Technologies* Technical Support.

SpO_2 Sensors

Adhesive sensors are sterile and for single use only. Reusable sensors should be cleaned before reuse with a 70% alcohol solution. If low-level disinfection is required, use a 1:10 bleach solution. Do not use undiluted bleach (5% - 5.25% sodium chlorite) or any cleaning solution other than those recommended here because permanent damage to the sensor could occur. Do not sterilize the sensor by irradiation, steam, or ethylene oxide. If disposable sensors or their packaging are damaged, they must be disposed of as advised in this appendix.

To clean or disinfect the sensor:

1. Saturate a clean, dry gauze pad with the cleaning solution. Wipe all surfaces of the sensor and cable with this gauze pad.
2. Saturate another clean, dry gauze pad with sterile or distilled water. Wipe all surfaces of the sensor and cable with this gauze pad.
3. Dry the sensor and cable by wiping all surfaces with a clean, dry gauze pad.

Maternal SpO_2 Calibration

The 250cx Series Monitor automatically calibrates the pulse oximetry parameter upon power up, whenever a new sensor is attached, and at periodic intervals during use. The intensity of the sensor's LEDs are also automatically adjusted to compensate for differences in tissue density.

NIBP Maintenance

A leak test of the NIBP parameter should be performed at least once a year or when there is doubt about the validity of the pressure readings.

CAUTION
Refer calibration and leak testing to qualified service personnel. Full calibration details are available in the Corometrics 250cx Series Monitor Service Manual, available from GE Medical Systems *Information Technologies*.

Disposal of Product Waste

As you use the 250cx Series monitor, you will accumulate solid wastes that require proper disposal or recycling. These include patient applied parts and packaging material.

Patient Applied Parts

Certain patient applied parts, such as those with adhesive (disposable SpO_2 sensors), are intended for single use and should be disposed of properly as medical waste in accordance with regional body controlled guideline.

Other patient applied parts, such as blood pressure cuffs, should be cleaned according to instructions. Inspect reusable applied parts for wear, replace as necessary, and dispose of used product as medical waste in accordance with regional body controlled guideline.

Packaging Material

Retain original packaging materials for future use in storing or shipping the monitor and accessories. This recommendation includes corrugated shippers and inserts.

Whenever possible recycle the packaging of accessories and patient applied parts.

Monitor

At the end of its service life, the product described in this manual, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have questions concerning disposal of the product, please contact GE Medical Systems *Information Technologies* or its representatives.

16 Troubleshooting

This section of the manual provides a troubleshooting guide for the most basic 250cx Series Monitor operational problems. If the response to a specific question is not found, contact Technical Support.

Inside the United States: 1-800-558-7044

Outside the United States: Contact your local representative

For your notes

General Troubleshooting

General Troubleshooting		
Problem	Probable Cause	Possible Solution
No monitoring functions and green Power indicator does not illuminate when Power switch is placed in the On (I) position.	■ Monitor is not connected to an AC line receptacle. ■ The AC power cord is defective. ■ The AC outlet is defective. ■ The power cord is not connected to the monitor. ■ Blown fuses. ■ Power selector software has the wrong setting.	■ Connect the power cord to an AC line receptacle. ■ Replace the power cord. ■ Use a different outlet. ■ Connect the power cord to the monitor. ■ Call Biomedical Engineering Department.
■ Recorder does not function and the Record indicator is off. ■ Recorder does not function and the Record indicator flickers three short flashes every 5 seconds. ■ Recorder functions however, Record indicator flashes on and off every second. ■ Recorder does not function; the Record indicator is off; the message *PAPER INCORRECTLY LOADED*, *RELOAD WITH BLACK SQUARES DOWN* is shown in maternal waveform area. ■ Recorder does not function and the Record indicator is on.	■ Recorder is off, out of paper, or paper is incorrectly loaded. ■ Recorder is in maternal-only mode. ■ Paper supply is low. ■ Paper loaded backwards. ■ Service required.	■ Press Record button; or install/re-install paper (see 4-3), then press Record button. ■ Press Record button to turn on. ■ Install paper (see 4-3). ■ Re-install paper (see 4-3). ■ Call Biomedical Engineering Department.
Incorrect time and date.	■ Time incorrectly set. ■ Clock circuit or battery fault.	■ Access the *General Setup* screen and reset the time and date (see “Setup Section”). ■ Call Biomedical Engineering Department.
Battery Low Icon appears	■ Data Corruption ■ Battery needs service.	■ Cycle power. Access setup screens and reset last-used settings ■ Call GE Service to report
No heartbeat or pulse sounds.	■ Volume set too low. ■ Transducer not connected or is loose.	■ Press the Volume △ buttons or access the respective setup screen(s) (*FECG*, *US*, or *US2*) to increase the volume. ■ Ensure that each transducer is securely attached to monitor and applied to the patient.

Ultrasound Troubleshooting

Ultrasound Troubleshooting		
Problem	Probable Cause	Possible Solution
Ultrasound not functioning properly.	■ Transducer not properly connected to monitor. ■ Transducer placement. ■ Too little gel applied to transducer. ■ Defective transducer. ■ Active fetus or mother. Fetal arrhythmia or hiccups. Extreme maternal obesity. ■ No signal. ■ Service required.	■ Ensure that transducer is securely attached to monitor. ■ Wait before moving transducer; FHR often returns. Reposition transducer. ■ Apply more gel. ■ Replace transducer. ■ Use alternate technique. ■ Auscultate FHR. ■ Call Biomedical Engineering Department. ■ Check maternal pulse to ensure monitoring of FHR.
Static noise on ultrasound.	■ Active fetus. ■ Environmental noise. ■ Maternal movement. ■ Defective transducer.	■ Reposition transducer. ■ Keep sheets and gown off transducer. Do not hold transducer with hand. ■ Use alternate monitoring mode. ■ Replace transducer.
Rate on FHR area of display and FHR trend on strip chart paper do not correlate.	Monitor is set for 30 bpm/cm vertical scale and 20 bpm/cm vertical scale strip chart recorder paper is being used (or vice versa).	Call Biomedical Engineering Department.

FECG Troubleshooting

FECG Troubleshooting		
Problem	Probable Cause	Possible Solution
Internal FECG erratic or not recording properly.	■ Cable not properly connected to monitor. ■ Attachment pad or legplate not securely attached to patient. ■ Electrode wire not secure in legplate post. ■ Paste is dried or incorrect paste is being used. ■ Electrode not properly attached. ■ No FECG signal. ■ Defective electrode. ■ Defective attachment pad. ■ Service required.	■ Ensure cable is securely attached to the monitor. ■ Secure attachment pad or legplate to patient. ■ Inspect legplate connection. ■ Check ECG paste; re-apply, if necessary. ■ Replace electrode. ■ Auscultate FHR. ■ Replace electrode. ■ Replace attachment pad. ■ Call Biomedical Engineering Department.
Rate in FHR area of the display and the FHR trend on the strip chart paper do not correlate.	Monitor is set for 30 bpm/cm vertical scale and 20 bpm/cm vertical scale strip chart recorder paper is being used (or vice versa).	Call Biomedical Engineering Department.

External Uterine Activity Troubleshooting

External UA Troubleshooting		
Problem	Probable Cause	Possible Solution
Tocotransducer not recording contractions.	■ Transducer not properly connected to monitor. ■ Transducer not properly placed. ■ Transducer not secured to patient. ■ Defective transducer/cable assembly. ■ No maternal contractions. ■ UA Reference range exceeded.	■ Ensure that transducer is securely attached to monitor. ■ Reposition transducer. ■ Secure or re-apply transducer to patient. ■ Replace transducer/cable assembly. ■ Wait. ■ Loosen belts or remove transducer from patient. Press UA Reference button while no pressure is applied to transducer button. Re-apply transducer. Do not overtighten belt. Press UA Reference button again between contractions. (See “Out of Range Condition” on page 6-4 for further information.)

External UA Troubleshooting		
Problem	Probable Cause	Possible Solution
Flashing "+" sign.	mmHg > 100 (13.3 kPa)	Press the UA Reference button between contractions.
CHECK TOCO message is shown in *UA* area of the display area when the UA Reference button is pressed.	■ UA Reference button pressed before UA circuits stabilized. ■ UA Reference range exceeded due to over-tightening belt. ■ Transducer defective. ■ Service required.	■ You must wait 10 seconds following powering on the monitor and/or connecting to the UA connector. ■ Loosen belts or remove transducer from patient. Press UA Reference button while no pressure is applied to transducer button. Re-apply transducer. Do not overtighten belt. Press UA Reference button again between contractions. (See "Out of Range Condition" on page 6-4 for further information.) ■ Replace transducer. ■ Call Biomedical Engineering Department.

Internal UA Troubleshooting

Internal UA Troubleshooting		
Problem	Probable Cause	Possible Solution
Internal pressure not measuring correctly.	■ Cable not properly connected to monitor. ■ Catheter has fallen out of place. ■ Catheter zeroed. ■ Service required.	■ Ensure cable is securely attached to monitor. ■ Replace catheter. ■ Calibrate catheter. ■ Call Biomedical Engineering Department.
CHECK IUP message displayed in *UA* area of the display.	■ Blockage or kinked catheter. ■ Fetus pressing directly on catheter. ■ Defective catheter. ■ Service required.	■ Flush catheter. Re-zero. Replace catheter if necessary. ■ Reposition by twisting catheter. ■ Replace catheter. ■ Call Biomedical Engineering Department.

MECG Troubleshooting

MECG Troubleshooting		
Problem	Probable Cause	Possible Solution
MECG erratic or not functioning properly.	■ Cable not properly connected to monitor. ■ Electrodes not properly placed. ■ Clips not attached to electrodes properly. ■ Electrode gel dried. ■ Defective MECG cable. ■ Selected lead providing inadequate signal. ■ Service required.	■ Ensure cable is securely attached to monitor. ■ Re-apply electrodes. ■ Check clip attachments. ■ Check electrodes and change if necessary. ■ Replace cable. ■ Change lead selection on *MHR/P Setup* screen. ■ Call Biomedical Engineering Department.
Dashes (– – –) shown in MHR/P area of display.	Monitor unable to make a determination due to insufficient signal.	Ensure patient is not asystolic. Ensure electrodes are firmly secured to patient.

Blood Pressure Troubleshooting

Blood Pressure Troubleshooting		
Problem	Probable Cause	Possible Solution
High reading.	Measurement taken during uterine contraction.	■ Annotate chart, then take a manual reading in-between contractions. ■ If possible, cancel reading during contraction. ■ Enable the monitor's Smart BP feature.
CHECK CUFF message displayed in *NIBP* area of display.	■ Improper cuff position. ■ Loose cuff. ■ Air pressure error. ■ Maternal movement. ■ Hose not properly connected to monitor. ■ Neonatal cuff connected.	■ Reposition cuff. ■ Tighten cuff. ■ Contact Biomedical Engineering Department. ■ Restrict patient limb movement. ■ Ensure that hose is firmly attached to monitor. ■ Ensure an adult cuff is connected.
OVERPRESSURE message displayed in *NIBP* area of display.	■ Cuff pressure has exceeded the overpressure limit of 315 ± 15 mmHg (42.0 ± 2.0 kPa). ■ Kinked hose. ■ Blocked hose.	■ Restrict patient limb movement. If this is not the case, contact Biomedical Engineering Department to perform pneumatic test. ■ Check the external cuff for kinks.

Blood Pressure Troubleshooting		
Problem	Probable Cause	Possible Solution
COMM ERROR message displayed in *NIBP* area of display.	Communication error between the built-in NIBP parameter and the remainder of the monitor circuitry.	Call Biomedical Engineering Department.
MOTION message displayed in *NIBP* area of display.	■ Excessive maternal movement. ■ Maximum reading determination time exceeded.	■ Talk to patient about the importance of minimizing limb movement. ■ Reposition cuff. ■ Check patient for arrhythmia. Move cuff to another limb.
REPAIR message display in *NIBP* area of display.	System error or self-test failure.	Contact Biomedical Engineering Department.
WEAK SIGNAL? message	Monitor unable to make a determination due to insufficient signal.	Assess patient situation.

Maternal Pulse Oximetry Troubleshooting

Maternal Pulse Oximetry Troubleshooting		
Problem	Probable Cause	Possible Solution
Dashes (– – –) shown in *MSpO$_2$* display area.	■ Monitor unable to make a determination due to insufficient signal. ■ Improperly applied sensor. ■ Excessive maternal movement. ■ Excessive ambient light. ■ Damaged sensor	■ Check patient. The patient may be experiencing shock, hypotension, severe vasoconstriction, severe anemia, hypothermia, arterial occlusion proximal to the sensor, or cardiac arrest. ■ Ensure that the intermediate cable is firmly attached to the monitor and to the sensor assembly. ■ Ensure sensor is not too tight. Move sensor to another location. ■ Restrict patient limb movement. Restrain limb if necessary. ■ Cover sensor with opaque material. ■ Replace sensor.
REPAIR message shown in *MSpO$_2$* area of display.	System error or self-test failure.	Contact Biomedical Engineering Department.
SENSOR message shown in *MSpO$_2$* area of display. (Nellcor only)	Wrong MSpO2 cable and/or sensor connected to the monitor.	Check the type of MSpO$_2$ technology your monitor contains (the label next to the lower, right-hand side of the display) and use the corresponding cables and sensors for that technology.

17 Technical Specifications

This section contains a detailed list of the technical specifications for the 250cx Series Monitor.

For your notes

General Monitor

General Monitor Technical Specifications					
Category	Technical Specifications				
Power Requirements					
Nominal Line Voltage:	100VAC	120 VAC	220 VAC	230 VAC	240 VAC
Line Frequency:	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz	50/60 Hz
Power Consumption (maximum):	100 W	100 W	0.4 A	0.4 A	0.4 A
Chassis Leakage:	<300 μA				
Physical Characteristics					
Height:	6.7 in (17.0 cm)				
Width:	16.7 in (42.4 cm)				
Depth:	17.5 in (44.4 cm)				
Weight:	22.0 lbs (10.9 kg) approx.				
Environmental Conditions	Operating		Storage		
Monitor:					
Ambient Temperature:	50°F to 104°F (10°C to 40°C)		14°F to 131°F (–10°C to 55°C)		
Relative Humidity:	10% to 95%, non-condensing		0% to 95%, non-condensing		
Atmospheric Pressure:	700–1060 mbar (525–795 mmHg)		700–1060 mbar (525–795 mmHg)		
Strip Chart Paper[1]:					
Ambient Temperature:	50°F to 104°F (10°C to 40°C)		< 80°F (< 26.5°C)		
Relative Humidity:	30% to 70%, non-condensing		45% to 65%, non-condensing		
Atmospheric Pressure:	700–1060 mbar (525–795 mmHg)		700–1060 mbar (525–795 mmHg)		
Certification					
ANSI/AAMI EC13-1992:	Complies with all areas except those listed below: 3.1.2.1e: Heart Rate Meter Accuracy and Response to Irregular Rhythm (not tested) 3.2.6.1: Range of QRS wave amplitude and duration 3.2.7: Range and accuracy of heart rate meter (4.2.7 f: input rate of 300 bpm.) 3.2.8.1: Lower Alarm Limit (The lowest alarm limit on the 250cx Series is 35 bpm.) 3.2.9.7a: Output Display a) Channel Width 3.2.9.8c: Impulse Response 3.2.9.12: Pacemaker Pulse Display capability				
UL-2601.1:	Classified to UL-2601.1 Medical electrical equipment classified by Underwriter's Laboratories, Inc., with respect to fire, shock, and mechanical hazards in accordance with UL-2601.1.				
CUL:	Classified with respect to electric shock, fire, mechanical, and other specified hazards only, in accordance with CAN/CSA C22.2 No. 601.1				

[1] Paper operating environmental conditions are for a period of less than one month. Paper storage environmental conditions are for extended storage.

Operating Modes

Operating Mode Specifications	
CAUTION The monitor may produce incorrect results if operated outside the minimum specified parameter specifications in this table.	
FECG Mode	
Technique:	Peak detecting, beat-to-beat cardiotachometer
Heart Rate Counting Range:	30–240 bpm
Heart Rate Resolution:	± 1 bpm
Artifact Elimination:	Selectable, ± 25 bpm artifact rejection
Countable Input Signal Range:	15 µV to 2 mV peak-to-peak
Offset Voltage Tolerance (Differential):	± 300 mVdc maximum
Maximum Common Mode Voltage:	20 V peak-to-peak
Preamplifier Bandwidth:	1–90 Hz
Common Mode Rejection:	
Balanced:	> 120 dB at mains frequency, with patient cable
Unbalanced 5kΩ RA or LA:	> 110 dB at mains frequency
Input Equivalent Noise:	< 10 µV peak-to-peak
Input Impedance:	
Differential:	> 10 MΩ
Common Mode:	> 20 MΩ
Mains Frequency Rejection:	> 40 dB
Leakage Current:	< 60 µA at 254 VAC, electrically isolated
Isolation, Mains-to-Patient:	> 4 kVAC
Ultrasound Mode	
Technique:	Pulsed Doppler with autocorrelation processing
Transducer Type:	9-crystal
Pulse Repetition Frequency:	
Single Ultrasound Mode:	4 kHz
Dual Ultrasound Mode:	2 kHz
Pulse Duration:	92 µs
Transmitter Frequency:	1.151 MHz
Spatial-Peak Temporal Average Intensity:	Ispta < 10 mW/cm^2
Spatial-Average Temporal Average Intensity:	Isata< 5 mW/cm^2
Focal 20 dB Beam Area:	16.6 cm^2, at a range = 7 cm
Peak Instantaneous Intensity:	1.8 mW/cm^2
Peak-Negative Acoustic Pressure:	p < 10.0 kPa
Heart Rate Counting Range:	50–210 bpm
Leakage Current:	< 10 µA at 120–240 VAC, isolated by transducer
Uterine Activity Mode	Strain Gauge / Tocotransducer
Range:[1]	0–100 mmHg (0–13.3 kPa) / 0–100 mmHg (0–13.3 kPa)
Resolution:	1 mmHg (0.13 kPa) / 1 mmHg (0.13 kPa)
Bandwidth:	dc to 0.5 Hz / dc to 0.5 Hz
Excitation Voltage:	+4.0 Vdc
Zero Set Temperature Drift:	< 0.1 mmHg/°C (0.013 kPa/°C), excluding transducer
Leakage Current:	< 60 µA at 254 VAC, electrically isolated

[1]The ranges shown here are typical ranges seen in a clinical setting.

Operating Mode Specifications (Continued)	
MECG Mode	
Technique:	Peak detecting, beat-to-beat cardiotachometer
Maternal ECG Electrode Type:	Medtronic 1700-003 or equivalent
Leads Available:	I, II, and III
Heart Rate Counting Range:	30–240 bpm
Heart Rate Resolution:	± 1 bpm
Heart Rate Update Rate:	> 1 update per second
Countable Input Signal Range:	0.5 mV to 5 mV peak-to-peak
Baseline Drift:	< 0.5 mV RTI
Tall T-wave Rejection:	0.8 **x** QRS amplitude
Heart Rate Meter Response Time:	
80–120 bpm Step Increase:	< 2 seconds
80–40 bpm Step Decrease:	< 3 seconds
Alarm Time for Tachycardia 80–200 bpm:	< 10 seconds (high alarm limit at 100 bpm)
Offset Voltage Tolerance (Differential):	± 300 mVdc maximum
Maximum Common Mode Voltage:	20 V peak-to-peak
Preamplifier Bandwidth:	0.6 to 40 Hz
Common Mode Rejection:	
Balanced:	> 80 dB at mains frequency, with patient cable
Unbalanced 5K RA or LA:	> 50 dB at mains frequency
Input Equivalent Noise: Input Impedance:	< 30 μV peak-to-peak
Differential:	> 2.5 MΩ
Common Mode:	> 10 MΩ
Mains Frequency Rejection:	> 40 dB
Leakage Current:	< 60 μA at 254 VAC, with cable, electrically isolated
Isolation, Mains-to-Patient:	> 4 kVAC
Leads Off Detection:	dc current < 0.1 μA
Alarms:	
Audio:	Alternating 1.5-second chimes
Visual:	Flashing heart rate numeric or message
Limits:	User-selectable high and low maternal heart rate
Technical:	Leads off
Tachycardia Response Time:	< 8 seconds
Pacemaker Detection/Rejection:	
Input Voltage Range:	± 2.5 mV to ± 700mV
Input Pulse Width:	0.1 to 2 ms
Pulse Rise/Fall Time:	< 10% of pulse width; not greater than 100 μs
Overshoot/Undershoot:	2 mV

CAUTION

Excessive overshoot time of pacemaker pulse may cause false QRS detection.

Operating Mode Specifications (Continued)	
Maternal Blood Pressure Mode (DINAMAP® SuperSTAT) Technique:	Oscillometric. Microprocessor software eliminates most ambient noise and motion artifact.
Blood Pressure Range: Systolic Diastolic Visual Mean Arterial Pressure (MAP)	30–290 mmHg (4.0–38.7 kPa) 10–220 mmHg (1.3–29.3 kPa) 20–260 mmHg (2.7–34.7 kPa)
Pulse Rate Range:	30–200 bpm
Blood Pressure Accuracy:	± 5 mmHg (0.7 kPa) with a standard deviation no greater than 8 mmHg (1.1 kPa)
Pulse Rate Accuracy:	± 2 bpm or ± 2% (whichever is greater)
Cuff Inflation:	Initial inflation to 135 mmHg (18.0 kPa). Subsequent inflation approximately 30 mmHg (4.0 kPa) greater than the previous systolic pressure.
Inflation Pressure Range:	100-250 mmHg in increments of 5 (13.3 ± 33.3 kPa in steps of 0.7)
Cuff Deflation:	Automatic
Safety Features:	Automatic cuff deflation if: cuff pressure exceeds the overpressure limit of 315 mmHg ± 15 mmHg (42.0 ± 2.0 kPa); or maximum reading determination time is exceeded (not to exceed AAMI /ANSI SP10-1992 limit of 180 s); or safety timer detects microprocessor failure. Auto mode minimum 30-second delay from the end of one determination to the beginning of another to allow for venous return.
Display/Record:	Systolic, diastolic, and mean pressure; pulse rate
Alarms: Audio Visual Limits	Alternating 1.5-second chimes Flashing pressure numeric or message User-selectable high and low systolic, diastolic, and mean pressures; User-selectable high and low pulse rate
Technical	Cuff errors, connection errors, insufficient signal, excessive inflation or determination times, overpressure, hose errors, excessive motion, communication problem, or self-test failure.
Compliance:	The 250cx Series blood pressure parameter complies with the American National Standard for Electronic or Automated Sphygmomanometers [AAMI/ANSI SP10-1992]. The GE monitor values are based on the oscillometric method of noninvasive blood pressure measurement and correspond to comparisons with intra-aortic values within ANSI/AAMI Standards for accuracy.
This device is covered under one or more of the following US Patents: 6,423,010; 6,358,213; 5,704,362; 5,680,870; 5,579,776; 5,518,000; 5,170,795; 5,052,397; 4,754,761; 4,638,810 and international equivalents. USA patents pending.	

Operating Mode Specifications (Continued)	
Maternal Pulse Oximetry Mode (Masimo)	
Technique:	Spectrophotometry and plethysmography.
Sensor Accuracy[1]:	
Sensor Model	LNOP® DC-I, LNOP-Adt, LNCS PC-I, and LNCS-Adt
Weight Range	> 30 kg
Saturation No Motion	± 2%
Accuracy Motion	± 3%
Pulse Rate No Motion	± 3 bpm
Accuracy Motion	± 5 bpm
Low Perfusion Saturation	± 2%
Accuracy Pulse Rate	± 3 bpm
Measurement Range:	
Saturation Range (SpO_2%)	1%-100%
Pulse Rate (bpm)	25-240 beats/min
Perfusion	0.02%-20%
Accuracy and Motion Tolerance:	
Saturation (SpO_2%)	
During no motion conditions - Adults[2]	70%-100% ± 2 digits
During motion conditions - Adults[3]	70%-100% ± 3 digits
Low Perfusion	70%-100% ± 2 digits 0%-69% unspecified
Wavelengths:	
Red	663 nm, nominal
Infrared	880 nm, nominal
Maximum Optical Output Power:	
Radiant Power at 50 mA pulsed	0.13 mW, minimum 0.79 mW, maximum
Pulse Rate (bpm)	
During no motion conditions - Adults	25 to 240 bpm ± 3 digits
During motion conditions - Adults	25 to 240 bpm ± 5 digits
Resolution:	
Saturation (SpO_2%)	1%
Pulse Rate (bpm)	1
Low Perfusion Performance[4]:	
>0.02% Pulse Amplitude and % Transmission > 5%	Saturation (SpO_2%) ± 2 digits Pulse Rate ± 3 digits
Alarms:	
Visual	Flashing SpO_2 numerics or message
Audio	Alternating 1.5-second chimes
Interfering Substances	Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, or any substance containing dyes, that change usual arterial pigmentation may cause erroneous readings.

Operating Mode Specifications (Continued)	
Maternal Pulse Oximetry Mode (Masimo continued)	

[1] Accuracy specified when used with Masimo SET pulse oximetry modules using PC or LNC series patient cables. Numbers represent ± 1 standard deviation.Plus or minus one standard deviation represents 68% of the population.SpO_2 accuracy from 70% to 100%.Pulse Rate accuracy from 25 to 240 bpm.

[2]The Masimo SET® SpO_2 parameter with LNOP-Adt sensors has been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

[3]The Masimo SET SpO_2 parameter with LNOP-Adt sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz at an amplitude of 1 to 2 cm and a non repetitive motion before 1 to 5 Hz at an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population. Masimo SET technology with LNOP and LNCS sensors have been validated with human blood studies on healthy adult volunteers with induced hypoxia studies. The volunteer population composed of both men and women spanned a range of skin pigmentations from light to dark and ranged in age from 22 to 40 years old.

[4]The Masimo SET SpO_2 parameter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus, one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

NOTE: Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within ± A_{rms} of the value measured by a CO-Oximeter.

NOTE: Use of a functional SpO_2 simulator to assess the accuracy of the Corometrics 250cx SpO_2 parameter has not been demonstrated.

This device is covered under one or more of the following US Patents:5,482,036;5,490,505;5,632,272;5,685,299; 5,758,644; 5,769,785; 6,002,952; 6,036,642; 6,067,462; 6,206,830; 6,157,850 and international equivalents. USA and international patents pending.

Operating Mode Specifications (Continued)	
Maternal Pulse Oximetry Mode (Ohmeda)	
Technique:	Spectrophotometry and plethysmography
Sensor Type[1]:	OxiTip+ OXY-AP and OxiTip+ OXY-F
Pulse Rate Accuracy:	30-250 bpm; ± 2 digits or ± 2%, whichever is greater (no motion) 30-250 bpm; ± 5 digits or ± 5%, whichever is greater (with motion) 30-250 bpm; ± 3 digits or ± 3%, whichever is greater (during low perfusion)
Saturation Range:	0-100%
Pulse Rate Range:	30-250 bpm
Saturation Accuracy:[2]	Accuracy, A_{rms} (root mean square of paired values; previously represented by ± 1 standard deviation) 70-100% ± 2 digits (without motion) 70-100% ± 3 digits (during clinical motion)[1] 70-100% ± 2 digits (during clinical low perfusion) Below 70% unspecified
Wavelengths:	
Red	650-670 nm
Infrared	930-950 nm
Maximum Optical Output Power:	10.5 mW
Alarms: (audio and visual)	
Audio	Alternating 1.5-second chimes
Visual	Flashing SpO_2 numeric or message
Limits	User-selectable high and low SpO_2, and high and low pulse rate
Technical	Sensor errors, connection errors, insufficient signal, excessive motion, communication problem, internal calibration error, or self-test failure.

[1] Applicability: OxyTip+ Adult/Pediatric. Accuracy of Oxy-F sensors has not been validated under clinical motion conditions. Ohmeda sensor accuracy tests were done with 13 healthy adult subjects. The volunteer population was composed of 3 females and 10 males. The ages ranged from 19 to 35 years old. The weights ranged from 120 to 185 lb with a mean weight of 158 lb. The skin tones were as follows: 2 African-American and Jamaican subjects with dark pigmentation, 1 Asian subject with light yellow pigmentation, 1 Hispanic subject and 1 Mexican subject with medium pigmentation, and 8 Caucasian subjects with light to medium pigmentation. OxyTip+ OXY- AP sensor has been validated under motion condition. Three types of motion artifacts were evaluated: mechanically induced tapping at 3 Hz, random frequency clinical rubbing motion with hand in prone position, and random frequency clinical rubbing motion with hand in supine position.

[2] OxyTip+ sensors are validated during low perfusion conditions. Low perfusion was achieved by having the room chilled to 60-68º F, keeping the left side of the subject warm and the right side cooled to a perfusion index level <= 0.1. Saturation readings were compared against a reference system that was compared to arterial blood draws.

NOTE: Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within ± A_{rms} of the value measured by a CO-Oximeter.

NOTE: Use of a functional SpO_2 simulator to assess the accuracy of the Corometrics 250cx SpO_2 parameter has not been demonstrated.

This device is covered under one or more of the following US Patents: 5,503,148, 5,766,127, 5,934,277, 6,381,479, 6,385,471, 6,397,092, 6,408,198, 6,415,166, 6,434,408, 6,505,060, 6,505,133, 6,510,329, 6,650,918, 6,707,257, 6,714,803.

Operating Mode Specifications (Continued)	
Maternal Pulse Oximetry Mode (Nellcor)	
Technique:	Spectrophotometry and plethysmography.
Sensor Type and Accuracy[1]:	SpO_2 Range:
OxiMax® Sensor Models	70%–100%:
MAX-A[2],	± 2 digits
DS-100A	± 3 digits
Saturation Range:	1–100%
Pulse Rate Range:	30–250 bpm
Accuracy:	
Saturation (SpO_2%)	
Adults[2]	70%-100% ± 2 digits
Low Perfusion[3]	70%-100% ± 2 digits 0%-69% unspecified
Pulse Rate (bpm)	
Adults	20 to 250 bpm ± 3 digits
Wavelengths:	
Red	660 nm, nominal
Infrared	890 nm, nominal
Maximum Optical Output Power:	< 15 mW
Response Time:	Fast
Alarms (audible and visual):	Alternating 1.5-second chimes
Audio	Flashing SpO_2 numeric or message
Visual	User-selectable high and low SpO_2; User-selectable high and low pulse rate
Limits	Sensor errors, connection errors, insufficient signal, communication problem, internal calibration error, or self-test failure.
Technical	

[1] Accuracy specifications are based on controlled hypoxia studies with healthy, non-smoking adult volunteers over the specified saturation SpO_2 range. Pulse oximeter SpO_2 readings were compared to SaO_2 values of drawn blood samples measured by hemoximetry. All accuracies are expressed as ± "X" digits. This variation equals ± one standard deviation (± 1 SD), which encompasses 68%of the population.Oxygen saturation accuracy can be affected by certain environmental and patient physiological conditions, as discussed in the operator's manual for the monitor. Use Nellcor sensors only with 250cx Series Monitors containing Nellcor oximetry. Consult individual manufacturers for accuracy specifications and compatibility information of particular instruments and Nellcor sensor models. The volunteer population was composed of healthy men and women recruited from the local population. The ages ranged from 18 to 50 years old, with variations of skin pigmentations.

[2] Adult specifications are shown for OxiMax®MAX-A and MAX-N sensors with the N-600. Saturation accuracy will vary by sensor type.

[3] Applicability: OxiMax® MAX-A, MAX-AL, MAX-P, MAX-I, and MAX-N sensors.

[4] Information of wavelength range can be especially useful to clinicians performing photodynamic therapy.

NOTE: Because pulse oximeter equipment measurements are statistically distributed, only about two-thirds of pulse oximeter equipment measurements can be expected to fall within ± A_{rms} of the value measured by a CO-Oximeter.

NOTE: Use of a functional SpO_2 simulator to assess the accuracy of the Corometrics 250cx SpO_2 parameter has not been demonstrated.

This device is covered under one or more of the following Patents: US Patent No. 4,802,486; 4,869,254; 4,928,692; 4,934,372; 4,960,126; 5,078,136; 5,485,847; 5,743,263; 5,865,736; 6,035,223; 6,298,252; 6,463,310; 6,591,123; 6,675,031; 6,708,049; 6,801,797; Re. 35,122; and foreign equivalents.

Maternal Vital Signs History	
Storage/Recall:	8 hours, maximum

Strip Chart Recorder

Strip Chart Recorder Technical Specifications		
Heart Rate Scale	Domestic	International
Chart Width:	7 cm	8 cm
Scaling:	30 bpm/cm	20 bpm/cm
Range:	30–240 bpm	50–210 bpm
Resolution:	1 bpm	1 bpm
Uterine Activity Scale	Strain Gauge	Tocotransducer
Chart Width:	4 cm	4 cm
Scaling:	25 mmHg (3.3 kPa)/cm	25 mmHg (3.3 kPa)/cm
Range:	0–100 mmHg (0–13.3 kPa)	0–100 mmHg (0–13.3 kPa)
Resolution:	1 mmHg (0.13 kPa)	1 mmHg (0.13 kPa)
Maternal Pulse Oximetry $MSpO_2$ Scale	Domestic	International
Chart Width:	4 cm	4 cm
Scaling:	12.5%/cm or 25%/cm	12.5%/cm or 25%/cm
Range:	60–100% or 0–100%	50–100% or 0–100%
Resolution:	1%	1%
Recorder Drive		
Speeds:	1, 2, and 3 cm/min	
Speed Accuracy:	± 1%	

NOTE: Specifications are subject to change without notice.

18 Supplies & Accessories

This section provides an overall listing of supplies and accessories for use with 250cx Series Monitors. To order any of the supplies and accessories listed in this manual:

Inside the United States: Call 1-800-558-7044

Outside the United States: Contact your local representative

For your notes

General Add-Ons Ordering Information

General Supplies	
Item	Catalog Number (REF)
Remote Event Marker	3919BAO
Model 2116B Clinical-Notes/Data-Entry System	2116BAX
Model 146 Fetal Acoustic Stimulator	0146AAY
Exergen® TAT-5000™ Assembly - ^{0}F	2036641-001
Exergen® TAT-5000™ Assembly - ^{0}C	2036641-002
Exergen® TAT-5000™ Probe Covers (1000 count)	EX134203
Exergen® TAT-5000™ Probe Covers (5000 count)	EX 134205

Paper Supplies Ordering Information

Paper Supplies	
Item	Catalog Number (REF)
Z-Fold Chart Paper Pack, 30–240 bpm Heart Rate Scale (40/carton)	4305CAO
Z-Fold Chart Paper Pack, 50–210 bpm Heart Rate Scale (40/carton)	4305DAO

Ultrasound Ordering Information

Ultrasound Supplies	
Item	Catalog Number (REF)
Loop-Style Ultrasound Transducer (Nautilus), 8-foot Cord	5700LAX
Button-Style Ultrasound Transducer (Nautilus), 8-foot Cord	5700HAX
Ultrasound Coupling Gel Bottle, 250 ml (12/carton)	2434AAO
Reusable Belt for Loop-Style Transducer, Mesh Style (10/carton)	4425AAO
Reusable Belt for Loop-Style Transducer, Velcro Style (10/carton)	4425CAO
Reusable Belt for Button-Style Transducer, Blue (10/carton)	2015827-001
Reusable Belt for Button-Style Transducer, 1 pink and 1 blue/pack (100 packs/case)	2015919-001
Semi-Reusable Belt for Loop-Style Transducer, Velcro Style (1pink and 1 blue/pack; 50 packs/carton)	4425FAO
Single-Patient Use Belt for Loop-Style Transducer, Foam Style with Velcro Closure	8024AAO

FECG Ordering Information

FECG Supplies	
Item	Catalog Number (REF)
Qwik Connect *Plus* Spiral Electrode (50/carton)	7000AAO
Leg Plate for Qwik Connect *Plus* Spiral Electrode, 8-foot Cord (round connector)	1590AAO
Leg Plate for Qwik Connect *Plus* Spiral Electrode, 8-foot Cord (rectangular connector)	1591AAO
Attachment Pads for Qwik Connect *Plus* Spiral Electrode Legplate (50/carton)	2464AAO

Tocotransducer Ordering Information

Tocotransducer Supplies	
Item	Catalog Number (REF)
Loop-Style Tocotransducer (Nautilus), 8-foot Cord	2264LAX
Button-Style Tocotransducer (Nautilus), 8-foot Cord	2264HAX
Reusable Belt for Loop-Style Transducer, Mesh Style (10/carton)	4425AAO
Reusable Belt for Loop-Style Transducer, Velcro Style (10/carton)	4425CAO
Reusable Belt for Button-Style Transducer, Blue (10/carton)	2015827-001
Reusable Belt for Button-Style Transducer, 1 pink and 1 blue/pack: (100 packs/case)	2015919-001
Semi-Reusable Belt for Loop-Style Transducer, Velcro Style (2/pack; 50 packs/carton)	4425FAO
Single-Patient Use Belt for Loop-Style Transducer, Foam Style with Velcro Closure	8024AAO

IUPC Ordering Information

IUPC Supplies and Accessories	
Item	Catalog Number (REF)
Saflex IUPC with Amnio Infusion/Sampling Capabilities (10/carton)	2076BAO
Saflex Intermediate Cable	1336AAO

MECG Ordering Information

Defibrillator protection requires the use of GE Medical Systems *Information Technologies* recommended cables.

MECG Supplies and Accessories	
Item	Catalog Number (REF)
FECG/MECG Y Adapter Cable	1442AAO
FECG Socket Adapter, accepts 1590AAO QuikConnect® Plus Leg Plates	1442BAO
MECG Cable for use with detachable leadwires, USA/AHA, Rectangular Connector	1553AAO
MECG Cable for use with detachable leadwires, Intl./IEC, Rectangular Connector	1553BAO
Multi-Link Cable, 3-lead ECG Maternal, AHA, 12 ft. (3.6m) Round Connector (Requires 1442AAO)	1554AAO
Multi-Link Cable, 3-lead ECG Maternal, IEC, 12 ft. (3.6m) Round Connector (Requires 1442AAO)	1554BAO
Multi-Link Snap Leadwires, Set of 3, Grouped Detachable, 31 inches	411203-001
Multi-Link Snap Leadwires, Set of 5, Individually Detachable, 31 inches	411200-001
Multi-Link Grabber Leadwires, Set of 3, Grouped Detachable, 31 inches	412682-001
Multi-Link Grabber Leadwires, Set of 5, Individually Detachable, 31 inches	414556-001
Leadwire Adapter, 3-Lead Multi-Link to 3-Lead DIN	414371-001
Electrodes, Round, Foam, Pouches of 30, Case of 300	9431-004

NIBP Ordering Information

NIBP Supplies and Accessories	
Item	Catalog Number (REF)
Air Hose for Dual-Tube, Threaded-Luer Cuff, 12-foot Hose	9461-217
Reusable Single-Tube, Male-Luer Cuff, Small Adult, 18–26 cm Range	5531CAO
Reusable Dual-Tube, Threaded-Luer Cuff, Small Adult	E27795
Reusable Single-Tube, Male-Luer Cuff, Adult, 25-35 cm Range	5522CAO
Reusable Single-Tube, Male-Luer Cuff, Large Adult, 33-47 cm Range	5523CAO
Reusable Dual-Tube, Threaded-Luer Cuff, Adult, 25-35 cm Range	5522AAO
Reusable Dual-Tube, Threaded-Luer Cuff, Large Adult, 34-47 cm Range	5523AAO
Reusable Dual-Tube, Threaded-Luer Cuff, Adult Thigh, 46-66 cm Range	5524AAO

NIBP Supplies and Accessories	
Item	Catalog Number (REF)
Single-Patient Use, Dual-Tube, Locking-Luer Cuff, Small Adult, 18-26 cm Range (10/carton)	900373-003
Single-Patient Use, Dual-Tube, Locking-Luer Cuff, Adult, 25-35 cm Range (10/carton)	900373-002
Single-Patient Use, Dual-Tube, Locking-Luer Cuff, Large Adult, 33-47 cm Range (10/carton)	900373-001
NIBP Cuff Hose Adapter	414876-001

$MSpO_2$ Ordering Information

$MSpO_2$ Supplies and Accessories	
Item	Catalog Number (REF)
Ohmeda OxyTip+ Adult Adhesive Sensor (10/box)	OXY-AP-10
Ohmeda OxyTip+ Adult Adhesive Sensor (25/box)	OXY-AP-25
Ohmeda OxyTip+ Interconnect Finger Sensor	OXY-F-UN
Intermediate Cable for Nellcor Sensors	2025350-001
Intermediate Cable for Masimo LNOP Sensors	2017002-003
Intermediate Cable for Ohmeda Sensors	OXY-ES3
Nellcor Durasensor Adult Reusable Finger Probe	407705-006
Masimo Sensor LNOP Adult Reusable Finger Probe	E9008JC/2002800-001
Masimo Sensor LNCS Adult Adhesive (20/box)	2027253-001
Masimo Sensor LNCS Adult Reusable Finger Probe	2027258-001
Intermediate Cable for Masimo LNCS Sensors	2027263-001

Peripheral Device Ordering Information

Peripheral Device Supplies and Accessories	
Item	Catalog Number (REF)
Interface Cable to Nellcor Model N-200/M-400 Pulse Oximetry Monitor, 6-foot	1557BAO
Interface Cable to Nellcor Model N-200/N-400 Pulse Oximetry Monitor, 1-foot	1557AAO
RS-232C Interface Cable to Quantitative Sentinel/Perinatal System	1558AAO

A Factory Defaults

Factory Defaults are found in the table that follows. Factory defaults settings are dependent upon the model purchased.

For your notes

Table of Defaults

Summary of Factory Defaults				
Setup Screen	Field Description	Factory Default	Default Options	Hospital Preference
FECG or US/US2	FHR Volume	5	0-9	
	FHR Alarm Limits	High Low 160 120 bpm	200-140, Off 60-140, Off	
	Audio Alarms	On	On, Off	
	Volume	5	1-9	
NIBP	Initial Target Pressure	135 mmHg (18.0 kPa)	100-250 mmHg (13.3-33.3 kPa) in increments of 5 mmHg (0.7 kPa)	
	Mode	Manual	Manual, 1, 2, 3, 4, 5, 10, 15, 20, 30, 40, 45, 60, 90, 120 min	
	NIBP Done Vol	5	0-9	
	Alarm (mmHg mode) Systolic Diastolic MAP MHR/P	High Low 160 90 mmHg 90 50 mmHg 140 50 mmHg 120 50 bpm	High Low 70-240 50-150 70-130 30-120 70-150 30-120 100-250 35-120	
	Alarm (kPa mode) Systolic Diastolic MAP MHR/P	High Low 21.3 12.0 kPa 12.0 6.7 kPa 18.7 6.7 kPa 120 50 bpm	High Low 9.3-32.0 6.7-20.0 9.3-17.3 4.0-16.0 9.3-20.0 4.0-16. 100-250 35-120	
	Volume	5	1-9	

Summary of Factory Defaults				
Setup Screen	Field Description	Factory Default	Default Options	Hospital Preference
$MSpO_2$	Response Time (Nellcor 506)	Fast	Normal, Fast	
	Response Time (Nellcor NELL-3)	Fast	Fast	
	Averaging Time (Masimo)	8 seconds	2, 4, 8, 10, 12, 14, 16 seconds	
	Sensitivity (Masimo)	Normal	Normal, Maximum	
	Print Interval	5 minutes	Off, 2, 5, 10, 15, 30, 60 minutes	
	$\%O_2$ Trace	Off	On, Off	
	Alarms $MSpO_2$ MHR/P	High Low 100 95% 120 50 bpm	High Low 85-100 80-99 100-250 35-120	
	Volume	5	1-9	
MHR/P	Source	Auto	Auto, MECG, $MSpO_2$, NIBP	
	MHR/P Trace	Off	On, Off	
	Volume	0	0-9	
	Alarms	High Low 120 50 bpm	High Low 100-250 35-120	
	Alarm Volume	5	1-9	
	MECG Lead	II	I, II, III	
	Pacer	Off	On, Off	
Normal Operation	(Waveform Display)	MECG	FECG, MECG, $MSpO_2$, Off	
	(MECG Waveform Size)	1X (1 mV/cm)	0.25X, 0.5X, 1X, 2X, 4X, Auto	

Summary of Factory Defaults				
Setup Screen	Field Description	Factory Default	Default Options	Hospital Preference
Master Alarm Setup	Alarm Limits (mmHg) Systolic Diastolic MAP MHR/P $MSpO_2$	High Low 160 90mmHg 90 50 mmHg 140 50 mmHg 120 50 bpm 100 95%	High Low 70-240 50-150 70-130 30-120 70-150 30-120 100-25 35-120 85-100 80-99	
	Alarm (kPa mode) Systolic Diastolic MAP MHR/P	High Low 21.3 12.0 kPa 12.0 6.7 kPa 18.7 6.7 kPa 120 50 bpm	High Low 9.3-32.0 6.7-20.0 9.3-17.3 4.0-16.0 9.3-20.0 4.0-16. 100-250 35-120	
	Volume	5	1-9	
General Setup	Play Song	Off	Off, Happy Birthday, Brahms' Lullaby, Rock-a-Bye-Baby, All	
	Song Volume	5	0-9	
	Temp Done Volume	5	0-9	
	Brightness	9	0-9 (nine = brightest)	
	Paper Speed	United States: 3 cm/min International: 1 cm/min	1-3 cm/min	
	Date	Set to current local date.	Set to current local date.	
	Time	Set to current local time. Must manually change to EST/EDT.	Set to current local time.	
	$MSpO_2$ Print Interval (External Monitor)	5 min	Off, 2, 5, 10, 15, 30, 60 min	
	$FSpO_2$ Print Interval (External Monitor)	5 min	Off, 2, 5, 10, 15, 30, 60 min	
	$FSpO_2$ Trace	Off	Off, On	
Vital Signs History	HX Interval	Event	1, 5, 10, 15, 30, 60, Event	

Summary of Factory Defaults				
Setup Screen	Field Description	Factory Default	Default Options	Hospital Preference
Install Options Screen 1 (Service)	Language	Set according to shipping destination	Set according to shipping destination	
	Line Frequency	United States: 60 Hz International: 50 Hz	50 Hz, 60 Hz	
	Scaling	United States: 30–240 bpm International: 50–210 bpm	United States: 30–240 bpm International: 50–210 bpm	
	Recorder Font Size	Medium	Small, Medium, Large	
	FECG Artifact Elimination	Off	On, Off	
	Paper Chime	Out Only	Off, Low/out, Out only	
	Paper Chime Volume	5	1-9	
	HBC (Heartbeat Coincidence Enable)	On	On, Off	
	HR Offset (Applies to US or US2—whichever is FHR2)	10 min	Off, On, 10 min	
	FM (Fetal Movement) Remote Marker	On	On, Off	
	SpO_2 Scale	0–100%	Auto, 0-100% (Does not change)	

Summary of Factory Defaults				
Setup Screen	Field Description	Factory Default	Default Options	Hospital Preference
Install Options Screen 2 (Service)	Fetal Alert/Alarm	Off	Off, Alarms, Alerts	
	Alert Suspend	Off	Off, On	
	Re-Alarm (MECG and SpO_2 only)	120 sec	120 - 300 seconds in 5-second intervals	
	VS (Vital Signs) Print Interval	Real Time	Real Time, Chart Style	
	Default TOCO Reference	10 in mmHg mode or 1.3 in kPa modes	5, 10, 15, 20, or 25 relative units in mmHg mode or 0.7, 1.3, 2.0, 2.7, or in 3.3 kPa mode	
	Smart BP	On	On, Off	
	NIBP 1-min Interval	On	On, Off	
	NIBP Display	On	On, 1, 2, 3, 5, 10, 15, 30 min	
	Pressure Units	mmHg China: kPa	mmHg, kPa	
	SatSeconds (Nellcor)	10	Off, 10, 25, 50, 100	
	Default Settings	Factory	Factory, Hospital	

B Fetal Movement Detection

Each monitor in the 250cx Series can be upgraded to include fetal movement detection. This feature is designed to detect *gross* fetal body movements and body movements with associated limb movement.

For your notes

Introduction

Availability

Fetal movement detection is an *option* which can be installed in your 250cx Series Monitor to function with the US channel. Contact your Sales Representative for information.

Methodology

Fetal movement detection (FMD) is designed to detect *gross* fetal body movements and body movements with associated limb movement. Corometrics defines *gross fetal body movement* as the "extension, flexion, or rolling over of the fetal trunk about the longitudinal axis of the body and associated limb movements." Movements of the extremities alone *may not* be detected. Eye movements *will not* be detected.

CAUTION
FALSE DETECTION—The following may be automatically detected as fetal movement: transducer movement and maternal movement such as coughing, laughing, repositioning, mother poking her abdomen, in addition to emesis, fetal hiccups, or twins. During fetal sleep, or in the event of a fetal demise, some of these detected movements may be confused with fetal movement.

Using Fetal Movement Detection While Monitoring

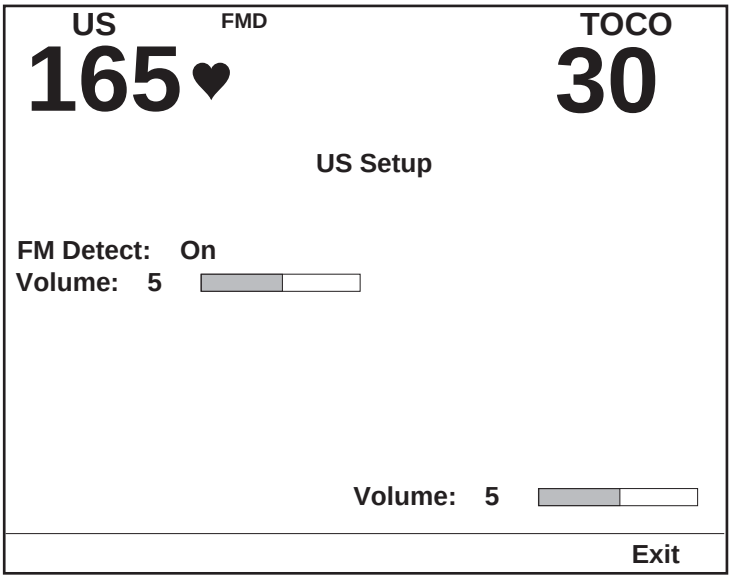
Enabling/Disabling Fetal Movement Detection

The fetal movement detection is available for the US connector only. FMD is *not* available for the US2 connector. To enable/disable fetal movement detection, set the *FM Detect* field on the *US Setup* screen to *On*. (Refer to Figure below.)

This field is only displayed: for the US connector; *and* if the option is installed in your monitor *and* if a transducer is plugged into the US connector. Rotating the Trim Knob control alternates between *On* and *Off*. (The factory default setting is *Off*.)

Display Indicator

When fetal movement detection is enabled, and a transducer is plugged in, the annotation *FMD* appears in-between the FHR1 and FHR2 mode titles. (Refer to Figure below.)



US Setup Screen

Strip Chart Annotation

When fetal movement detection is *enabled*, the mode annotation *FMD* - — prints following the FHR modes. The annotation provides an indication that the feature is enabled—it does not indicate detection.

When fetal movement is *detected*, a solid line is automatically marked on the bottom of the upper grid for the duration of the detected movement. (Refer to Figure, "Simulated Fetal Movement Detection Trace," on page B-5.)

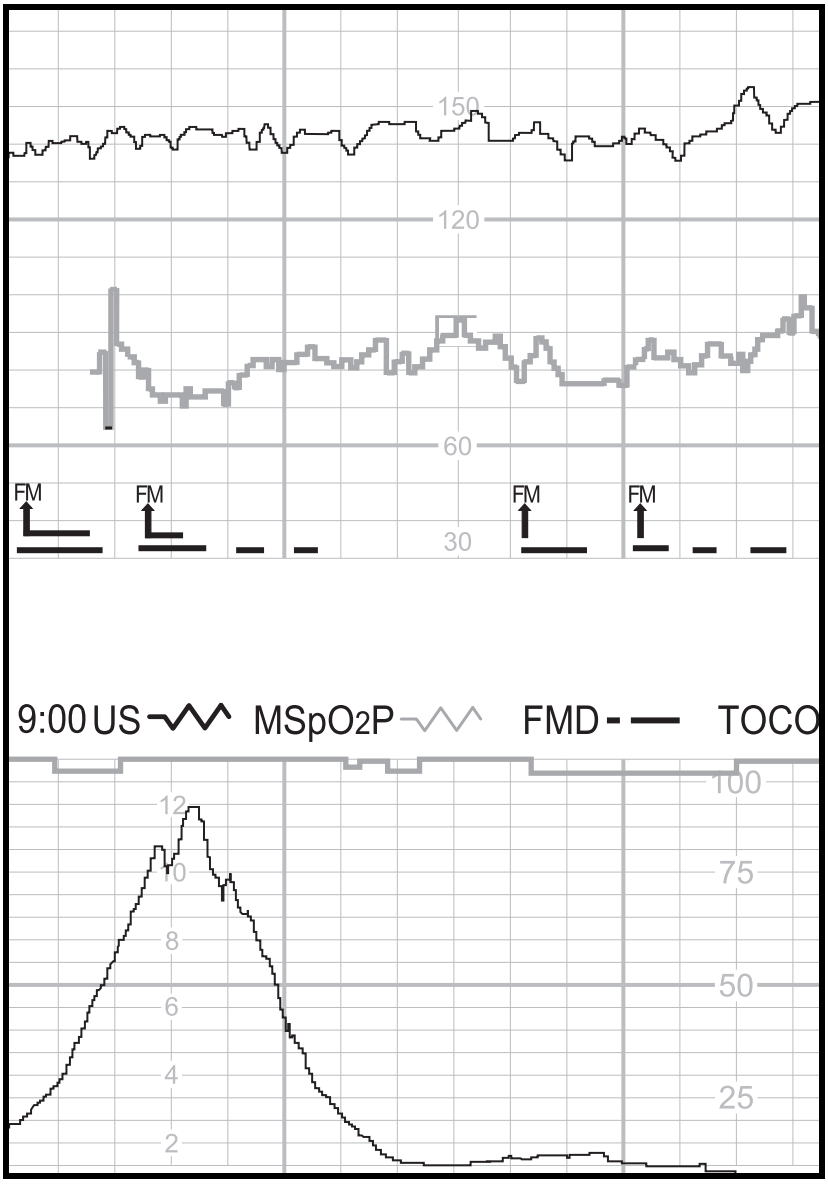
Using the FM Remote Marker to Complement the Patient Record

The FM Remote Marker is an accessory that can be used to complement the patient record.

1. Connect the Corometrics FM Remote Marker to the Remote Marker ↑ connector on the rear panel of the 250cx Series Monitor.
2. Instruct the mother to press the FM Remote Marker button whenever she feels fetal movement. Ask her to hold down the button for the duration of the perceived fetal movement. The annotation, ↑ or FM ↑ , with a horizontal bar, prints on the strip chart for as long as the button is held down. (Refer to Figure, "Simulated Fetal Movement Detection Trace," on page B-5.)

The annotation resulting from the FM Remote Marker can be configured as one of the following:

- ↑: commonly used to record a general event; or
- FM↑: commonly used as an indication that the mother has perceived fetal movement. (This is the factory default setting.)



Simulated Fetal Movement Detection Trace

C Spectra Alerts

Each monitor in the 250cx Series can be upgraded to include Spectra Alerts. Contact your Sales Representative for more information. This feature analyzes heart rate and uterine activity data to detect certain abnormal trends and alert the clinician. A Nurse Call Light Interface is also provided as part of the Spectra Alerts upgrade.

For your notes

Important Safety Information

IMPORTANT

INSTRUCTIONS FOR USE—It is mandatory that you read this chapter prior to operating a 250cx Series Monitor with the Spectra Alerts feature enabled. Keep this manual available for future reference and for the orientation of new personnel.

The Spectra Alerts option is designed to assist the perinatal staff in assessing the status of a patient at the bedside by recognizing normal and abnormal FHR and UA pattern features. The system does not replace observation and evaluation of the mother and fetus at regular intervals, by a qualified care provider, who will make diagnoses and decide on treatments or interventions. The user should determine the status of the patient at regular intervals (see "Standards for Obstetric-Gynecologic Services", 7th edition, Washington, D.C., ACOG, 1989) by visual assessment of the fetal monitor tracing at the bedside and evaluation of maternal vital signs and progress in labor. ***The absence of an alert does not indicate fetal or maternal well-being.***

The alert message and priority level are only a means to direct the staff's attention to the patient, since more than one parameter may be contributing to the alert condition. Visual assessment of the strip chart, combined with knowledge of patient history and risk factors are necessary to manage the situation appropriately.

The alert system will not detect every possible abnormality and cannot detect abnormalities that have not been clinically recognized and described in the literature. Frequent assessment of the fetal monitor tracing is necessary to ensure recognition of unusual, undefined, or suspicious patterns.

The care provider should only make the "diagnosis" of abnormal fetal heart rate patterns by personal assessment of the fetal monitor tracing from the bedside fetal monitor, not the alert message. The monitor requires data of a consistently good quality to recognize abnormalities. Artifact will limit its ability to recognize abnormalities. Increased variability, long and frequent accelerations, baseline changes, half-counting or double-counting, and poor or absent uterine activity are examples of factors which may limit detection capabilities.

Using the Spectra Alert Option

Enabling/Disabling Spectra Alerts

CAUTION
CIS—The Spectra Alerts option provides *bedside* alerts only. If you connect the 250cx Series Monitor to a Quantitative Sentinel or Spectra 400 Alert and Surveillance Central System you must disable the Spectra Alerts feature in the monitor.

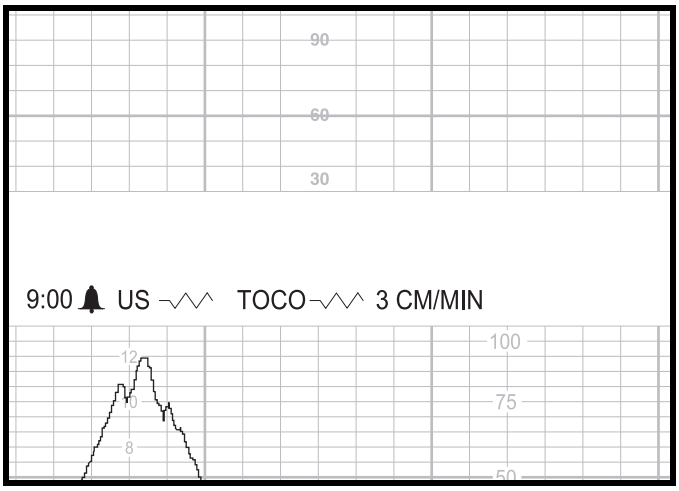
The Spectra Alerts option, when installed, is enabled/disabled from the *Fetal Alert/ Alarm* field on the password-protected *Install Options* service screen. FHR alarms and Spectra Alerts cannot be enabled at the same time. You may select one or the other; or you can disable them both. To effect a change to the Fetal Alarms setting, you must turn the monitor off, then back on again.

When the *Alerts* option is *enabled*, a solid bell icon displays next to the FHR mode title(s) and prints on the strip chart paper prior to the active FHR mode annotation(s). Refer to the Figure, “Spectra Alert Enabled Annotation,” on page C-5 and the Figure, “Example of a Level One Decelerations Alert,” on page C-6. This icon indicates that the feature is *enabled* only; it does not indicate the presence of an alert condition.

Methodology

The Spectra Alerts feature is designed to assist the perinatal staff in assessing the status of monitored patients by recognizing normal and abnormal pattern features. Medically researched pattern recognition techniques are utilized to detect when the pre-set limits[1] have been exceeded. When abnormal features are recognized by the system, these features are displayed on an *Alert Parameters* area on the *FECG, US,* or *US2 Setup* screen—whichever is affected. When the abnormal feature(s) meet the preset criteria for an alert, the monitor provides an audible and visual indication of that alert. When an alert condition is detected, the system categorizes the alert into one of three levels—with level three being the most severe. Refer to the “Possible Alert Conditions” Table.

[1]Limits are not user-selectable.



Spectra Alert Enabled Annotation

Possible Alert Conditions		
Level One Alert *	Level Two Alert **	Level Three Alert ***
■ decreased variability ■ flat variability ■ bradycardia (100–119 bpm) ■ tachycardia (161–180 bpm) ■ mild/moderate variable decelerations ■ mild/moderate sporadic decelerations ■ mild variable decelerations with decreased variability *or* mild tachycardia *or* mild bradycardia ■ tachycardia (161–180 bpm) with decreased variability ■ undefined decelerations ■ mild bradycardia *and* decreased variability ■ prolonged deceleration (>120 bpm) ■ increased variability ■ uterine hypertonus ■ tetanic uterine contraction (>60 sec) ■ signal quality	■ tachycardia (>180 bpm) ■ bradycardia (90–99 bpm) ■ late decelerations ■ severe variable or sporadic decelerations ■ tachycardia with flat variability ■ mild sporadic decelerations with decreased variability ■ moderate variable decelerations with tachycardia *or* bradycardia *or* decreased variability ■ mixed decelerations ■ mild bradycardia and flat variability ■ mild late or mixed decelerations with decreased variability *or* mild tachycardia ■ mild variables *and* flat variability ■ mild variables *and* mild tachycardia *and* decreased variability ■ prolonged deceleration (80–119 bpm)	■ bradycardia (<90 bpm) ■ prolonged deceleration (<80 bpm) ■ late, variable, or mixed decelerations with decreased variability *and* tachycardia *or* bradycardia ■ severe late or variable decelerations with tachycardia *or* bradycardia *or* decreased variability ■ moderate bradycardia *and* flat variability ■ any deceleration (except mild variables) *and* flat variability ■ late or severe variables with tetanic uterine contraction

Alert Indications

Active Alerts

When the system detects an alert condition, visual and audible indications are provided. (There is no printed indication of the alert.) The alert level, indicated by asterisks, flashes and displays in inverse video between the FHR1 and FHR2 areas; in addition, the associated FHR numerics flash. The audio indication is a pattern of beeps representing the alert level:

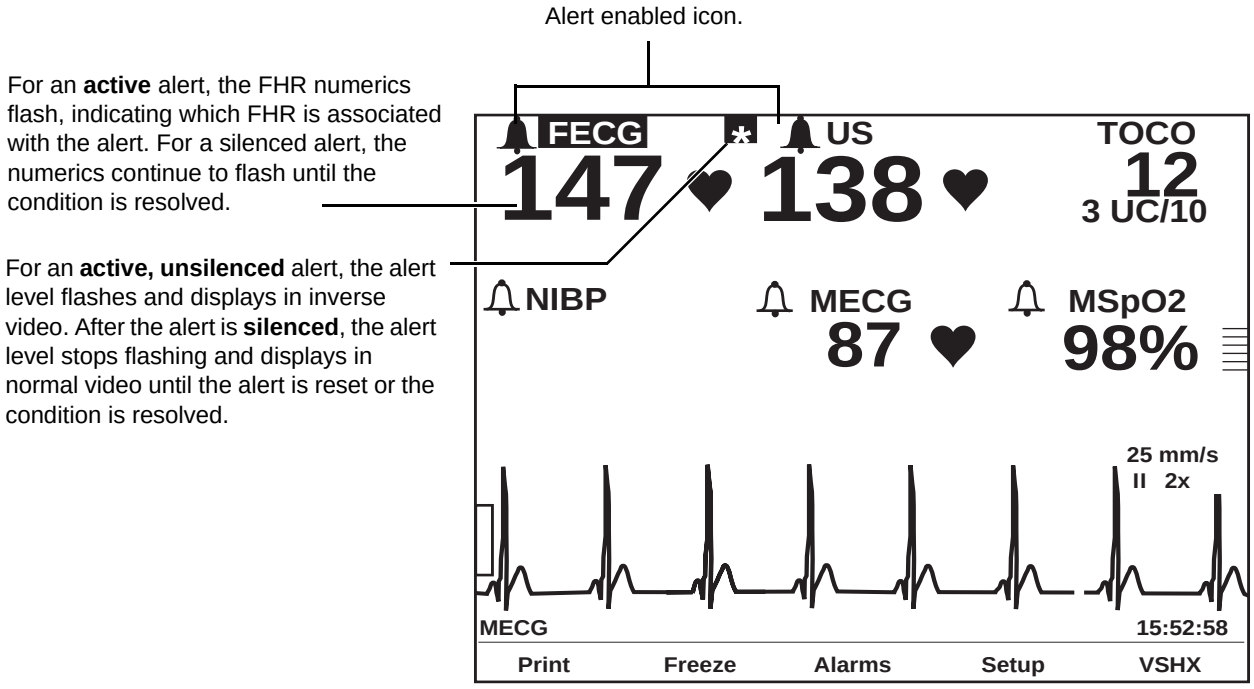
Level 1: Beep___Beep___Beep___ . . .

Level 2: BeepBeep___BeepBeep___BeepBeep___ . . .

Level 3: BeepBeepBeep___BeepBeepBeep___BeepBeepBeep___ . . .

"Beep" represents audio tone sets and "___" is the pause between sets.

The following figure provides an example of an active alert—level one decelerations.


Alert enabled icon.
For an **active** alert, the FHR numerics flash, indicating which FHR is associated with the alert. For a silenced alert, the numerics continue to flash until the condition is resolved.
For an **active, unsilenced** alert, the alert level flashes and displays in inverse video. After the alert is **silenced**, the alert level stops flashing and displays in normal video until the alert is reset or the condition is resolved.
FECG
147
US
138
TOCO
12
3 UC/10
NIBP
MECG
87
MSpO2
98%
25 mm/s
II 2x
MECG
15:52:58
Print
Freeze
Alarms
Setup
VSHX

Example of a Level One Decelerations Alert

Silencing Alerts

Press the Alarm Silence button to cancel the audio. The alert level stops flashing and displays in normal video; however, the associated FHR numerics continue to flash.

For an *active, silenced* alert, the visual indications remain present until the condition is resolved or the alert is reset. (Refer to "Resetting Alerts" on page C-12.)

Resolved Alerts

Resolved alerts function similar to the FHR alarms, yet differently from the maternal alarms.

- **Resolved, Unsilenced Alert:** You must acknowledge an alert—even if the condition has already been resolved. The visual and audible indication remain present until you press the Alarm Silence button. This ensures that a clinician is aware that an alert occurred. You may hear this type of alert described as *latching*.
- **Resolved, Silenced, Alert:** If you have already silenced an alert, the visual indications disappear automatically.

Alert Suspension Feature

When a care provider is at the patient's bedside, it may be desirable to suspend the ***audio*** component of alerts. When you suspend alerts, the audio indication is inhibited as well as the nurse call interface; the visual indications remain active and data continues to be assessed.

Enabling/Disabling the Alert Suspension Feature

The alert suspension feature must be enabled/disabled on the password-protected *Install Options* service screen. Refer to the 250cx Series Service Manual for more information.

The alert suspension feature has two settings:

- *Off* (disabled): users cannot activate the function.
- *On* (enabled): users can manually activate/de-activate the function.

Suspending Audio Alerts (and the Nurse Call Interface)

To suspend alerts, press and hold the Alarm Silence button for approximately 3 seconds; you will hear two beeps as feedback.

While suspended:

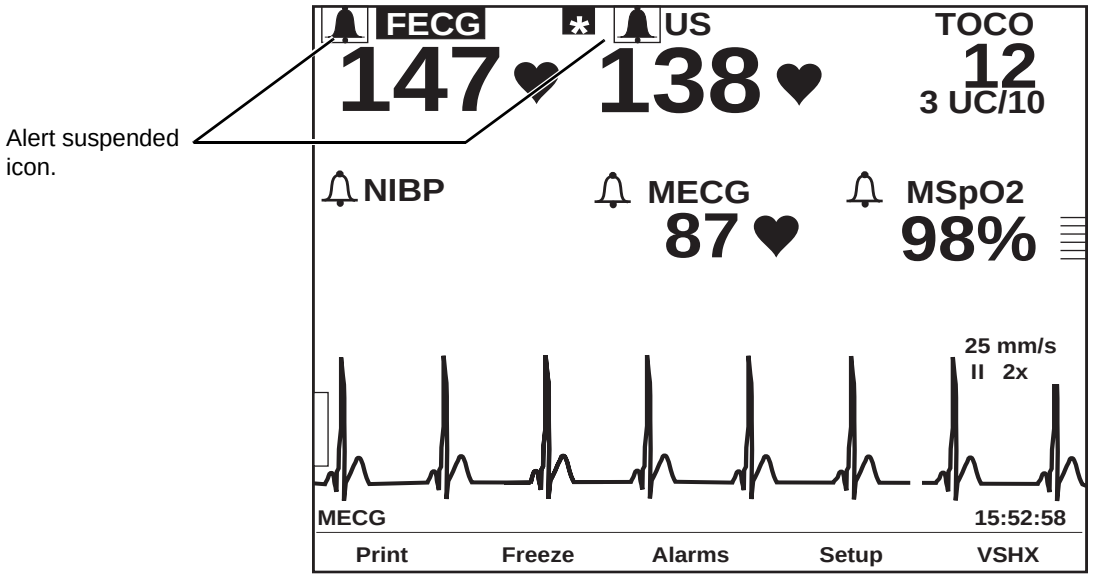
- alerts are only indicated visually on the monitor's display screen;
- an alert suspension icon displays next to the FHR mode title(s);
- an alert suspension icon prints on the strip chart paper along with the active FHR mode annotations(s); and
- alert output to a nurse call system is inhibited.

Refer to the figures on this page.

Restoring Audio Alerts (and the Nurse Call Interface)

To restore full alert functionality, press and hold the Alarm Silence button for approximately 3 seconds; you will hear two beeps as feedback.

Once restored, the alert enable icon : displays next to the FHR mode title(s); and prints on the strip chart paper along with the active FHR mode annotation(s).



Spectra Alert Suspended Icon

Spectra Alert Suspend/Restore Annotations

Alert Parameters Summary

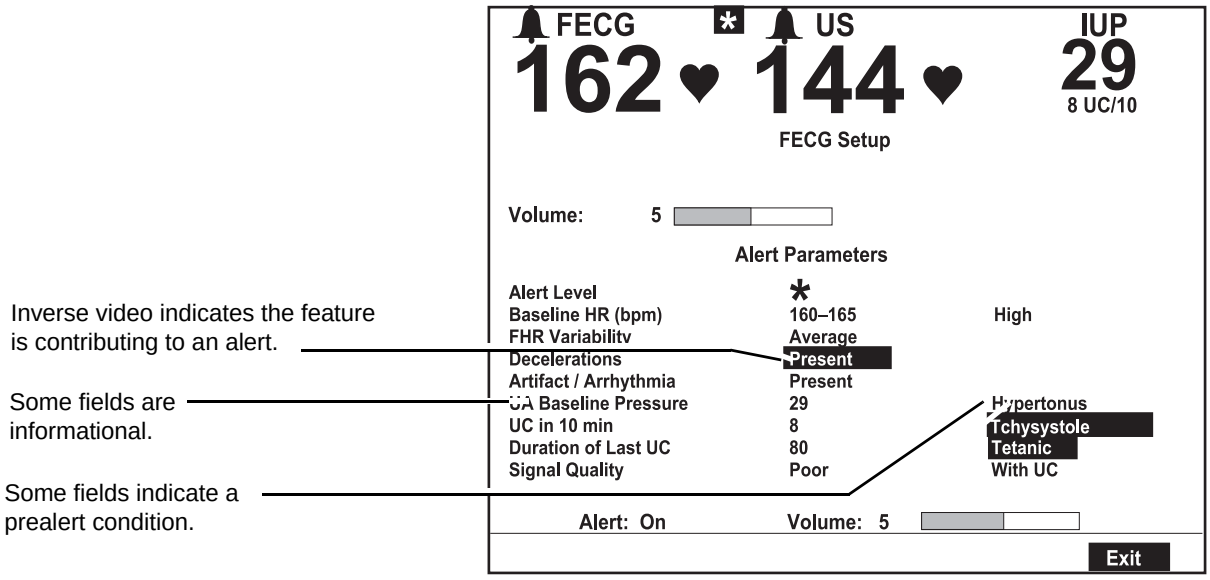
The FHR setup screens (*FECG* or *US/US2*) include an Alert Parameters summary presenting an overview of the alert analysis results for FHR and UA. Fields shown in inverse video are contributing factors to an alert. Some fields contain a second column to provide qualifying information. The Table, "Summary of Alert Parameters", provides a list of possible results which can appear in the Alert Parameters summary.

NOTE Parameters displayed in inverse video are contributing to an active alert. Items displayed in normal video may indicate an alert is pending.

Summary of Alert Parameters		
Parameter Label	Alert Analysis Result Possibilities	
	Column 1	Column 2
Alert Level		
Baseline HR (bpm)	*Range* *(For example: 145–150)*	*High* *Low* *Brady* *Tachy*
FHR Variability	*Unknown* *Average* *Increased* *Decreased* *Flat* *Increased* *Decreased* *Flat*	
Decelerations	*Absent* *Present* *Present*	
Artifact/Arrhythmia	*Present*	
UA Baseline Pressure	*pressure in relative units or mmHg (kPa when selected)*	*Hypertonus* *Hypertonus*
UC in 10 min	*# of UCs*	*Tachysyst* *Tachysyst*

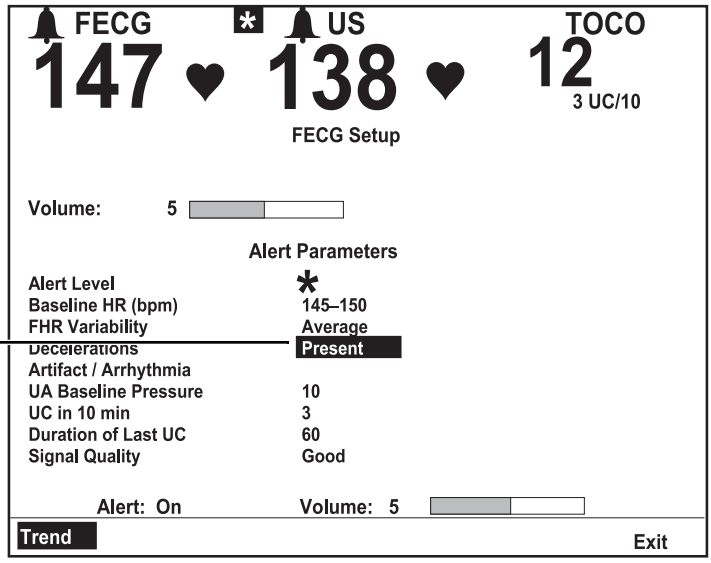
Summary of Alert Parameters		
Parameter Label	Alert Analysis Result Possibilities	
	Column 1	Column 2
Duration of Last UC	*# of seconds*	*Tetanic* *Tetanic*
Signal Quality	*Good* *Moderate* *Poor* *Unknown*	

The next Figure provides an example of an alert with two columns of information.



Alert Parameters Example with Two Columns of Alert Information

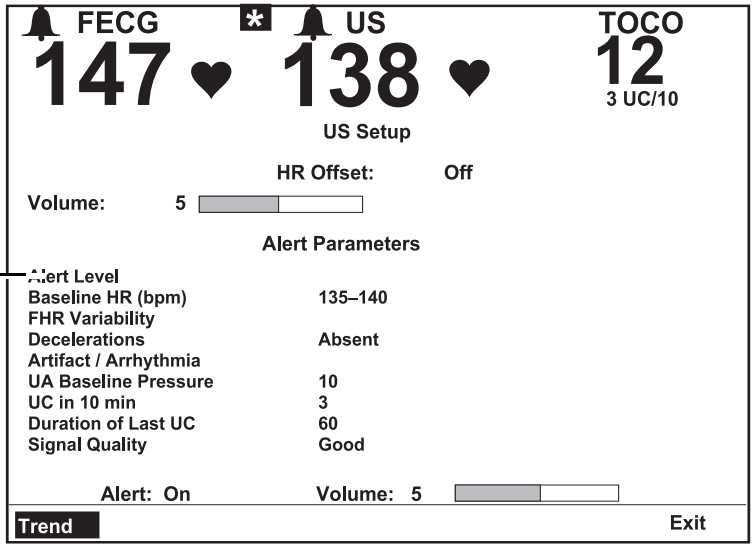
The following figure shows an example of alert parameters for a level one decelerations alert for FECG.



Items listed in inverse video are contributing factors to the alert. Other items *may* indicate an alert is pending.

Alert Parameters Example—FECG is the FHR associated with the alert

The next Figure shows an example of alert parameters for the *US Setup* screen when the FHR is not associated with any alert.



The alert level is blank indicating there is no active alert for this FHR. The alert parameter information is available, even if there is no alert associated with this FHR.

Alert Parameters Example—US is not associated with any alert

Resetting Alerts

If you do not agree with an alert (see "False Pattern Recognition" and "Mode Switching"), you can clear the data being used via the Alert field on the associated setup screen (*FECG* or *US/US2*).

NOTE FHR data is collected over time for analysis. Resetting an alert clears all data from the monitor's memory for both FHR1 and FHR2.

To reset an alert:

1. Access the setup screen associated with the alert—indicated by the flashing FHR numerics. Select the mode title softkey (*FECG* or *US/US2*).
2. Highlight the Alert field. Whenever you display the setup screen, this field is set to *On*.
3. Change the Alert field setting to *Reset*. (If you change the field to *Reset* by mistake and wish to change it back, simply set it to *On* again.)
4. Once an alert is reset: audio and visual indications are removed; and the alert parameters information clears.

NOTE It is possible that the Spectra Alerts feature may generate the same alert again.

False Pattern Recognition

The system may recognize accelerations as baseline.

Mode Switching

During dual FHR monitoring, the system may "confuse" the FHRs following mode switches after delivery of the presenting twin.

To guard against mode changes *prior to delivery* of the presenting twin: Use US for the presenting twin and US2 for the second twin. When switching to FECG for the presenting twin, disconnect the US connector which is no longer in use.

If an alert is generated *following delivery* of the presenting twin, evaluate the tracing to determine if there are any clinical factors contributing to the alert. If you feel the alert was generated in error, change the Alert field on the associated setup screen to Reset. Consider the following:

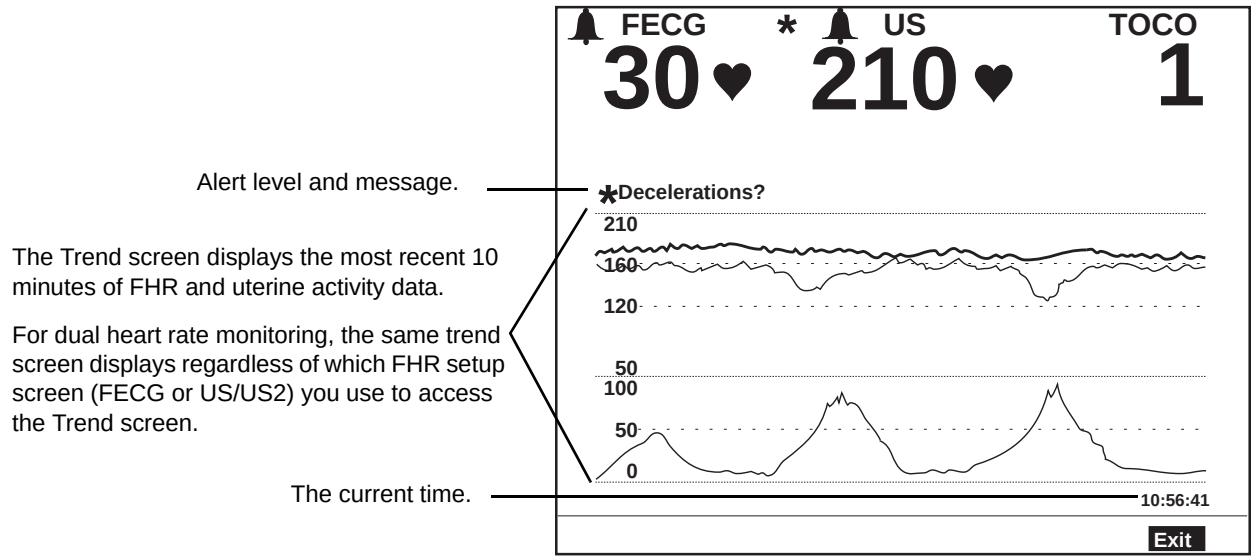
- If you continue monitoring the second twin with US2, and you disconnect the FECG transducer which is no longer in use: the US2 fetal heart rate now moves to the primary display; and the FHR trend, which was bold, now prints using a normal print density.
- If you later switch to internal monitoring for the second twin and you disconnect the US2 transducer which is no longer in use: the fetal heart rate for the second twin displays as FECG in the primary heart rate area; and the FHR trend continues to print using a normal print density.

Trend Screen

Select the *Trend* softkey from the FHR Setup screen to display the FHR/UA trend screen. (For dual fetal heart rate monitoring, you can access it from either mode's setup screen.) The Trend screen displays:

- the alert level and message, if present;
- the most recent 10 minutes of FHR and UA trend data—reflecting the paper scale and chart speed settings; and
- the current time.

The following Figure shows a sample Trend screen with dual FHR monitoring in progress and a level one decelerations alert.



Trend Screen Example

Uterine Contraction Frequency

The Spectra Alerts option includes a uterine contraction (UC) frequency display. When enabled, the UA screen:

- provides the setup field for the UA display;
- provides a uterine contraction audio indicator; and
- provides a UC frequency histogram which graphs the contractions per 10 minutes over the most recent 100 minutes.

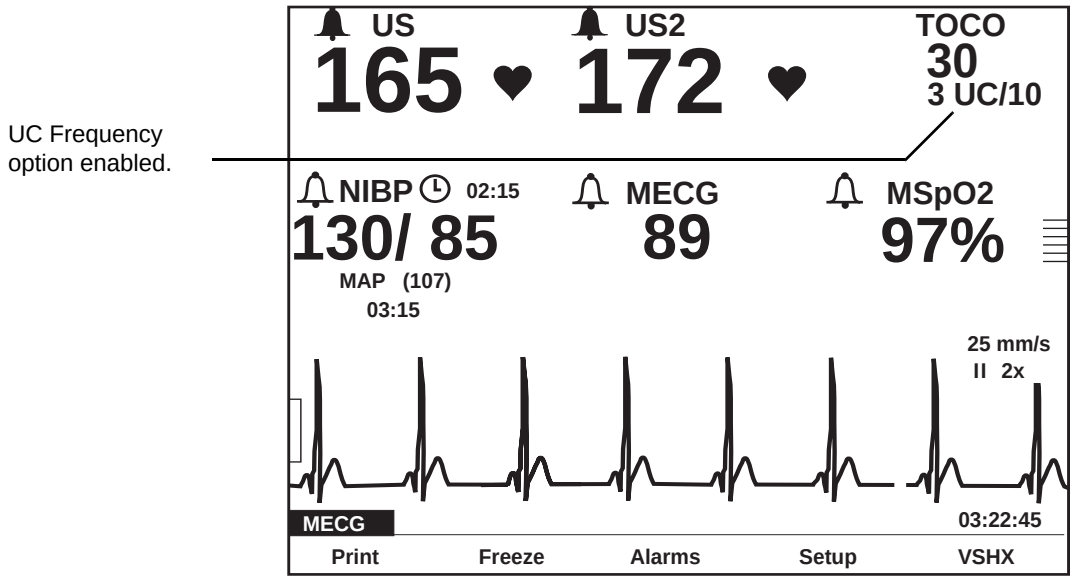
Enabling/Disabling UC Frequency Display

A UA Setup screen is automatically activated when the Spectra Alerts option is installed and enabled. To enable/disable the UC Display option:

1. Access the UA setup screen by selecting the UA mode title (*TOCO* or *IUP*).
2. Set the *UA Display* field to the desired setting: *UA* or *UA/UCF.* Refer to the Figure, "UC Frequency Histogram," on page C-15.

UC Frequency in UA Display Area

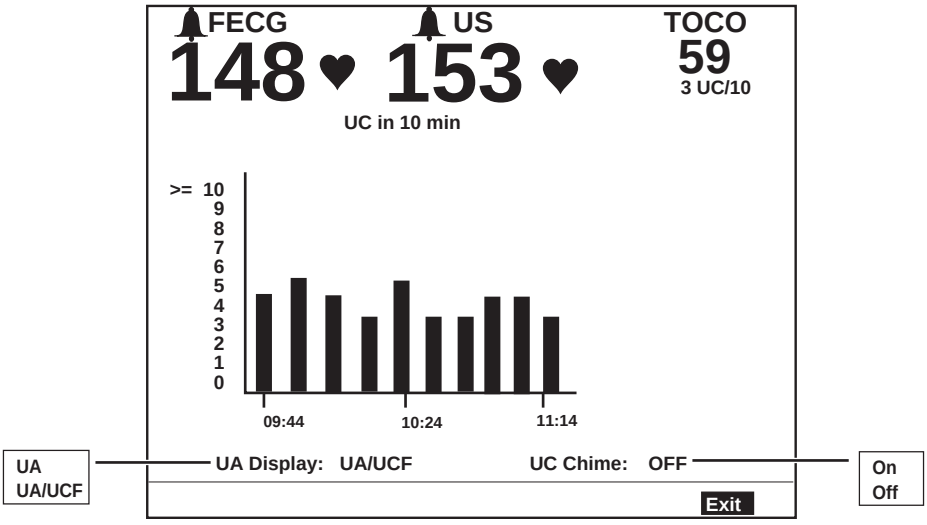
When enabled (*On*), the UC frequency, per 10 minutes, displays in the *UA* Display area; the UA value displays in a smaller size in order to accommodate the additional information. (See figure below.)



UC Frequency Option Enabled

UC Frequency Histogram

If the Spectra Alerts option is enabled, the UA Setup screen displays a UC Frequency Histogram as shown in the next Figure. Each bar in the graph represents the number of contractions in a 10-minute segment. The graph displays up to 10 bars (or 100 minutes).



UC Frequency Histogram

The following two messages may display above the UC Frequency Histogram: *RECORDING UA?* and *UA BASELINE SET?* For more information, refer to Table on pages C-17 through C-21.

Enabling/Disabling UC Chime

If the Spectra Alerts option is enabled, the UA Setup screen contains a *UC Chime* field. When enabled: a *low*-frequency chime sounds at the *onset* of a contraction; a *high*-frequency chime sounds at the *conclusion*. This audio contraction indicator is useful to caregivers as well as patients. Caregivers are made aware of contractions during internal exams or while making adjustments to internal sensors/transducers without having to watch the monitor. An anesthetized mother can use the indicator as a "push signal" if she is unable to feel contractions.

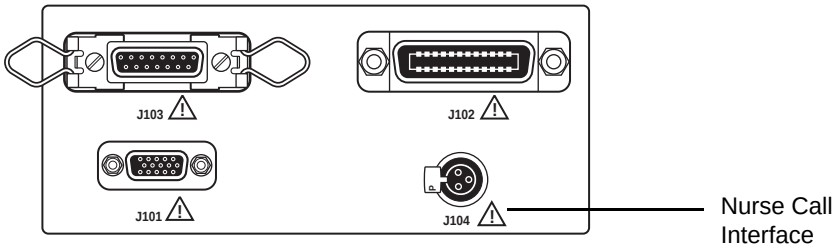
To enable/disable the *UC Chime:*

1. Access the UA setup screen by selecting the UA mode title (*TOCO* or *IUP*).
2. Set the *UC Chime* field to the desired setting: *On* or *Off*. Refer to the Figure, "UC Frequency Histogram".

Nurse Call Interface

The Spectra Alerts option includes a Nurse Call Interface rear panel connector, as shown in the Figure below. This connector attaches to a standard Nurse Call System. The connector's maximum output is 50 Vdc at 100 mA; the maximum on resistance is 0.5 Ω. When connected to a Nurse Call System, the monitor will activate the system each time a Spectra Alert is issued. This interface simulates pressing the button on a bedside Nurse Call System allowing nurses to respond to patient needs quickly and efficiently. Refer to the 250cx Series Service Manual for more information.

NOTE If the Spectra Alerts are suspended (see "Alert Suspension Feature" on page C-7), the Nurse Call output is inhibited during the suspension time.



250cx Series Rear Panel Communications Connectors

Alert Parameters

Summary of Alert Parameters				
ALERT PARAMETERS SUMMARY ON FHR SETUP SCREEN			TREND SCREEN	
Parameter	Column 1	Column 2	Message	Criteria
Alert Level	* ** ***		* ** *+ message?* ***	Alert has not been silenced.
			* ** - *message* ***	Alert has been silenced.
Baseline HR (bpm)	Average rate over past 10 minutes.	*High* *Tachy*	*BASELINE?*	Alert pending: FHR > 160 bpm for 5 minutes. Alert has not been silenced. Reflects the detection of baseline FHR > 160 bpm for 10 minutes.
		Tachy	*BASELINE?*	Alert silenced.
		Low *Brady*	*BASELINE?*	Alert pending. FHR < 120 bpm for 5 minutes. Alert has not been silenced. Reflects the detection of baseline FHR < 120 bpm for a pre-determined period of time. The alert occurs in 2–10 minutes, depending on how low the rate goes.
		Brady	*BASELINE?*	Alert silenced.
				Alert is deleted when baseline FHR is within the “normal” range for 10 minutes.

Summary of Alert Parameters				
ALERT PARAMETERS SUMMARY ON FHR SETUP SCREEN			TREND SCREEN	
Parameter	Column 1	Column 2	Message	Criteria
FHR Variability	*Unknown* (external)			
	Average (internal)			Baseline variability is determined to be 5–15 beats peak-to-peak.
	Increased			Alert pending. Approximately 5 minutes of baseline variability which is > 15 beats peak-to-peak.
	Increased		*VARIABILITY?*	Alert is issued if baseline variability remains increased for approximately 10 minutes ***and*** there are no other FHR alerts detected.
	Increased		*VARIABILITY?*	Alert silenced.
	Decreased			Alert pending. Reflects the detection of baseline variability which is < 4–5 beats peak-to-peak for approximately 10 minutes.
	Decreased		*VARIABILITY?*	Alert will be issued 20–40 minutes after decreased variability is detected. The "time-to-alert" depends on whether or not any other alert parameters are outside the normal range.
	Decreased		*VARIABILITY?*	Alert silenced.
	Flat			Alert pending. Absent variability detected for approximately 4 minutes.
	Flat		*VARIABILITY?*	Alert will be issued approximately 6–10 minutes after "flat" variability is detected.
	Flat		*VARIABILITY?*	Alert silenced.
				Alert is deleted if approximately 5 minutes of "better" variability is detected.
Decelerations	*Absent*			(May miss subtle decelerations.)
	Present			Deceleration with or without a contraction is detected. This indication may come and go prior to alert condition. Once an alert condition is detected, the word *Present* remains until the alert condition is resolved.

Summary of Alert Parameters				
ALERT PARAMETERS SUMMARY ON FHR SETUP SCREEN			TREND SCREEN	
Parameter	Column 1	Column 2	Message	Criteria
Decelerations	*Present?*		*DECELERATIONS?*	The analysis of deceleration characteristics has recognized features of either variable, late, mixed, or prolonged decelerations; or decelerations without uterine activity recorded. The baseline FHR ***and*** variability impact the monitor's ability to analyze patterns, as well as the "severity" of the pattern. The monitor attempts to integrate the baseline features with the deceleration features (onset, size, duration, etc.) to determine when to alert. The alert message is issued on the basis of 1, 2, or 3 decelerations depending on the size, shape, onset, duration, etc. ***and*** related baseline rate and variability. Examples: An alert occurs when: Three out of 5 contractions have mild variable decelerations; if baseline FHR is in normal range; and variability is average. Two out of 5 contractions have any decelerations (except early) if the variability decreased. One severe variable deceleration that drops to < 60 bpm for > 60 seconds. NOTE: Alert occurs in approximately 2 minutes. Alert silenced.
	Present?		*DECELERATIONS?*	The alert is deleted when there are 4 contractions without a deceleration; or 10 minutes without decelerations if no uterine contractions are present.
Artifact/Arrhythmia	*Present*			No alert. 5% of data in last minute may be PVCs, other arrhythmias, or artifact.

Summary of Alert Parameters				
ALERT PARAMETERS SUMMARY ON FHR SETUP SCREEN			TREND SCREEN	
Parameter	Column 1	Column 2	Message	Criteria
UA Baseline Pressure	# mmHg (kPa) (TOCO)			Uterine activity >40 mmHg (5.3 kPa) for 5 minutes. No alert. *UA BASELINE SET?* appears in Uterine Activity Display.
	# mmHg (kPa) (IUP)	*Hypertonus*		Uterine activity > 25 mmHg (3.3 kPa) for 5 minutes (7 minutes at start-up). No alert. *UA BASELINE SET?* appears in Uterine Activity Display.
		Hypertonus	*UA?*	Uterine activity > 35 mmHg (4.7 kPa) for 5 minutes. Alert has not been silenced.
		Hypertonus?	*UA?*	Alert silenced and question resolved. The alert is deleted after uterine activity is < 35 mmHg (4.7 kPa) for 5 minutes
UC (Uterine contractions) *in 10 min*	# of uterine contractions	*Tachysyst*		Six uterine contractions completed in 10 minutes, any size, internal or external. No alert.
		Tachysyst		If FHR Alert is present. The alert is deleted if there are < 6 uterine contractions in 10 minutes.
	If # ='blank'			Start-up: No contractions detected for 10 minutes. Continuous Monitoring: No contractions detected for 30 minutes. *RECORDING UA?* appears in Uterine Activity Display.
Duration of Last UC	# seconds	*Tetanic*	*UA?*	Alert has not been silenced. One uterine contraction with amplitude > 50 mmHg above baseline for 60 seconds.
		Tetanic	*UA?*	Alert silenced. The alert is deleted after one “normal” uterine contraction.

Summary of Alert Parameters				
ALERT PARAMETERS SUMMARY ON FHR SETUP SCREEN			TREND SCREEN	
Parameter	Column 1	Column 2	Message	Criteria
Signal Quality	*Good* *Moderate* *Poor* *Unknown* (appears when UC is the only active parameter)			Alert pending. Alert has not been silenced.
	Poor		*SIGNAL QUALITY?*	Three minutes of unsatisfactory data (FECG). Five minutes of unsatisfactory data (ultrasound).
	Poor		*SIGNAL QUALITY?*	Alert silenced. The alert is deleted after 3 minutes of satisfactory data.
	Poor	*With UC*		Data unsatisfactory with uterine contractions present.
	Poor	*With UC*	*SIGNAL QUALITY?*	Alert has not been silenced. Data between uterine contractions is acceptable; data during contractions is either poor quality or absent. Alert occurs after 1, 2, or 3 uterine contractions depending on what events preceded it.
	Poor	*With UC*	*SIGNAL QUALITY?*	Alert silenced.
				The alert is deleted following two uterine contractions with satisfactory data or 10 minutes of “good” data.
	no data		*REPAIR*	Message appears if there is a problem with the monitor or the Spectra Alerts option. Contact Biomedical Department or Service Representative.

D Frequently Asked Questions

FAQs

Question	Answer
NOTE: When the monitor is powered off, then on again, the settings revert back to the factory default settings or can be saved if you choose *Store Current to Hospital* in the password-protected *Install Options* screen.	
How do I change the alarm limits for Fetal Heart Rate 1	1. Rotate the Trim Knob to highlight the legend for FHR1. (This legend is at the top left on the display, and it may read *INOP*, *FECG*, *US*, or *US2*. 2. Once you highlight the FHR1 legend, press the Trim Knob. The display changes to show the <MODE> Setup screen, where mode is the current legend. 3. Now rotate the Trim Knob to highlight the FHR1 *High* heart rate alarm limit setting. 4. Once the *High* heart rate alarms limit is highlighted, press the Trim Knob again. The current setting in displayed in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value between *140 bpm* and *200 bpm* or *Off*. 6. Once you set the desired alarm value, press the Trim Knob again to confirm your selection. The current value setting stops blinking. 7. Repeat 3 through 6 for the *Low* heart rate alarm setting. The valid range is *60 bpm* to *140 bpm* or *Off*. NOTE: The software does not permit the alarm settings to overlap. 8. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 9. Press the Trim Knob again to return to the main monitoring display screen. NOTE: When the monitor is powered off, then on again, the settings revert back to the factory default settings or can be saved if you choose *Store Current to Hospital* from the password-protected *Install Options* screen.
How do I change the alarm limits for Fetal Heart Rate 2?	1. Rotate the Trim Knob to highlight the legend for FHR2. (This legend is at the top left on the display, and it may read *INOP* or *US2*. 2. Once you highlight the FHR2 legend, press the Trim Knob. The display changes to show the <MODE> Setup screen, where mode is the current legend. 3. Now rotate the Trim Knob to highlight the FHR2 *High* heart rate alarm limit setting. 4. Once the *High* heart rate alarms limit is highlighted, press the Trim Knob again. The current setting is displayed in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value between *140 bpm* and *200 bpm* or *Off*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Repeat 3 through 6 for the *Low* heart rate alarm setting. The valid range is *60 bpm* to *140 bpm* or *Off*. NOTE: The software does not permit the alarm settings to overlap. 8. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 9. Press the Trim Knob again to return to the main monitoring display screen. NOTE: When the monitor is powered off, then on again, the settings revert back to the factory default settings or can be saved if you choose *Store Current to Hospital* from the password-protected *Install Options* screen.

Question	Answer
How do I change the alarm limits for Non-Invasive Blood Pressure?	1. Rotate the Trim Knob to highlight the legend for *NIBP*. (This legend is slightly above center, on the left side of the display. 2. Once the *NIBP* legend is highlighted, press the Trim Knob. The display changes to show the *NIBP Setup* screen. 3. Rotate the Trim Knob to highlight the *Systolic High* alarm limit setting. 4. Once the *Systolic High* alarms limit setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value between *70 mmHg* and *240 mmHg (9.3 kPa and 32.0 kPa)*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Repeat 3 through 6 for the ■*Systolic Low:* select a value between *50 mmHg* and *150 mmHg (6.7 kPa and 20.0 kPa)*. ■*Diastolic High:* select a value between *70 mmHg* and *130 mmHg (9.3 kPa and 32.0 kPa*). ■*Diastolic Low:* select a value between *30 mmHg* and *120 mmHg (4.0 kPa and 16.0 kPa)*. ■*MAP* (Mean Arterial Pressure) *High*: select a value between *70 mmHg* and *150 mmHg (9.3 kPa and 20.0 kPa)*. ■*MAP Low:* select a value between *30 mmHg* and *120 mmHg (4.0 kPa and 16.0 kPa)*. ■You may optionally change the MHR/P (Maternal Heart Rate/Pulse) *High*: select a value between *100 bpm* and *250 bpm*. Note: The MHR/P alarm settings are also available through the *Pulse* legend, or the *$MSpO_2$* legend, on the main monitoring screen. ■You may optionally change the MHR/P *Low*: select a value between *35 bpm* and *120 bpm*. Note: The MHR/P alarm settings are also available via the *Pulse* legend, or the *$MSpO_2$* legend, on the main monitoring screen. 8. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 9. Press the Trim Knob again to return to the main monitoring display screen.
How do I change the alarm limits for MHR/P, Maternal Heart Rate Pulse?	1. Rotate the Trim Knob to highlight the legend for MHR/P. (This legend is located approximately in the center of the display and may indicate *MECG, Pulse* or *INOP,* depending on the settings that are currently enabled.) 2. Once the *MHR/P* legend is highlighted, press the Trim Knob. The display changes to the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to highlight the MHR *High* alarm limit setting. 4. Once the MHR *High* alarm limit setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value between *100 bpm* and *250 bpm*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting tops blinking. 7. Repeat 3 through 6 for the MHR *Low* alarm limit setting. Select a value between *35 bpm* and *120 bpm*. 8. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 9. Press the Trim Knob again to return to the main monitoring display screen.

Question	Answer
How do I enable the MHR/P, Maternal Heart Rate Pulse, trend recorder tracing?	1. Rotate the Trim Knob to highlight the legend for MHR/P. (This legend is located approximately in the center of the display, and may indicate *MECG, Pulse* or *INOP*, according on the settings that are currently enabled. 2. Once the *MHR/P* legend is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to highlight the *HR/PR*: setting. (It should read *Off*.) 4. Once the *HR/PR*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a setting of *On* (to enable MHR/P trace) or *Off*. 6. Once you set the desired trace setting, press the Trim Knob to confirm your selection. The current setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.
How do I change the source parameter for MHR/P, Maternal Heart Rate Pulse?	1. Rotate the Trim Knob to highlight the legend for MHR/P. This legend is located approximately in the center of the display, and may indicate MECG, *Pulse* or *INOP* according to the settings that are currently enabled. 2. Once the *MHR/P* legend is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to highlight the *Source*: setting. (It will read *Auto, $MSpO_2$, MECG.*) 4. Once the *Source*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select from *Auto, $MSpO_2$, MECG.* If you select *Auto*, the pulse value parameter is automatically selected according to the parameters that are currently enabled with precedence, highest to lowest, in the following order: *MECG, $MSpO_2$*. 6. Once you set the desired source parameter, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.
How do I enable the $MSpO_2$, Maternal Blood Oxygen Saturation, trend recorder tracing?	1. Rotate the Trim Knob to highlight the legend for *$MSpO_2$*. (This legend is located above the center, on the right side of the display.) 2. Once the *$MSpO_2$* legend is highlighted, press the Trim Knob. The display changes to show the *$MSpO_2$ Setup* screen. 3. Now rotate the Trim Knob to highlight the *$\%O_2$ Trace*: setting. (It should read *Off*.) 4. Once the *$\%O_2$ Trace*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a setting of *On* (to enable $MSpO_2$ trace) or *Off*. 6. Once you set the desired trace setting, press the Trim Knob to confirm your selection. The current setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.

Question	Answer
How do I change the alarm limits for $MSpO_2$, Maternal Blood Oxygen Saturation?	1. Rotate the Trim Knob to highlight the legend for *$MSpO_2$*. (This legend is slightly above center, on the right side of the display.) 2. Once the *$MSpO_2$* legend is highlighted, press the Trim Knob. The display changes to show the *$MSpO_2$ Setup* screen. 3. Now rotate the Trim Knob to highlight the current *High*: saturation percentage (%) alarm limit setting. 4. Once the *High*: saturation percentage (%) alarm limit setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select from 100 to 85%. 6. Repeat 3 through 6 for the *High*: saturation percentage (%) alarm limit setting. Select a value between 9*9%* and *80%*. ■You may optionally change the MHR/P (Maternal Heart Rate/Pulse) *High*: select a value between *100 bpm* and *250 bpm*. (The MHR/P alarm settings are also available through the *Pulse* legend, or the *NIBP* legend on the main monitoring screen.) ■You may optionally change the MHR/P *Low*: select a value between *35 bpm* and *120 bpm*. (The MHR/P alarm settings are also available via the *Pulse* legend, or the *NIBP* legend on the main monitoring screen.) 7. Once the desired source parameter is set, press the Trim Knob to confirm your selection. The current value setting stops blinking. 8. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 9. Press the Trim Knob again to return to the main monitoring display screen.
How do I change the waveform parameter being displayed?	1. Rotate the Trim Knob to highlight the waveform selection item. (This legend is slightly above the bottom menu bar, to the far left of the display, and should indicate one of the following: *Off*, *MECG*, *$MSpO_2$*, or *FECG*.) 2. Once the waveform selection item is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 3. Now rotate the Trim Knob to change the setting to *Off*, *MECG*, *$MSpO_2$*, or *FECG*. 4. Once you set the desired source parameter, press the Trim Knob to confirm your selection. The current value setting stops blinking. 5. The selected waveform parameter displays on the main monitoring screen.

Question	Answer
How do I change the Maternal ECG lead waveform being displayed?	Option 1 1. Rotate the Trim Knob to highlight the legend for *MHR/P.* (This legend is in the approximate center of the display and reads *MECG*, *Pulse* or *INOP*, according to the settings that are currently enabled.) 2. Once the *MECG* legend is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to highlight the *Source*: setting. (It will read *Auto*, *$MSpO_2$*, *MECG* or *NIBP.*) 4. If the *Source*: setting is not *MECG*, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting to *MECG*. 6. Once you set the desired source parameter, press the Trim Knob again to save the value. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *MECG Lead*: setting. This setting is slightly above vertical center towards the right side of the screen and indicates *Lead I, II* or *III.* 8. Now press the Trim Knob again. The current setting displays in blinking inverse video. 9. Now rotate the Trim Knob to change the current setting to the desired lead selection. 10. Once you set the desired source parameter, press the Trim Knob to confirm your selection. The current value setting stops blinking. 11. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 12. Press the Trim Knob again to return to the main monitoring display screen. Option 2 1. If the *MHR/P Source* setting is set to *Auto*, and MECG is currently enabled (plugged in) OR *MHR/P Source* is set to *MECG*, then, from the main monitor screen, rotate the Trim Knob to highlight the selected *Lead* setting for MECG. (This setting is slightly below vertical center, on the right hand side of the display. It will indicate *I, II* or *III*.) 2. Once the *MECG Lead* setting legend is highlighted, press the Trim Knob. The current setting displays in blinking inverse video. 3. Now rotate the Trim Knob to change the current setting to *MECG Lead* setting *I, II* or *III*. 4. Once you set the desired source parameter, press the Trim Knob to confirm your selection. The current value setting stops blinking and the waveform should reflect the selected lead.
How do I change the waveform vertical scale on the display?	1. To change the waveform scale, the current selected waveform must be *MECG* or *FECG*. The waveform scale cannot be altered when you view $MSpO_2$ plethsysmograph waveforms which auto-scale. 2. Rotate the Trim Knob to highlight the scale factor setting for the waveform display. (This setting is slightly below vertical center, on the right hand side of the display, below the horizontal speed indication of *25 mm/s.* The vertical scale indicates one of the following: *Auto, 0.25x, 0.5x, 1x, 2x,* or *4x.* 3. Once the *MECG* scale setting is highlighted, press the Trim Knob. The current setting displays in blinking inverse video. 4. Now rotate the Trim Knob to change the current setting to *Auto, 0.25x, 0.5x, 1x, 2x,* or *4x.* 5. Once you set the desired scale, press the Trim Knob to confirm your selection. The current value setting stops blinking, and the waveform should reflect the selected lead.

Question	Answer
How do I disable/enable Fetal Movement Detection? (FMD is an optional feature that is purchased separately.)	1. Rotate the Trim Knob to highlight the legend for *US*. (This legend is top left on the display.) Note: This feature applies only if ultrasound is the source. 2. Once the *US* legend is highlighted, press the Trim Knob. The display changes to show the *US Setup* screen where *US* (not *US2 Setup*) is the current legend. 3. Now rotate the Trim Knob to highlight the *FM Detect:* setting. This setting is *On* or *Off*. 4. Once the *FM Detect:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value of *On* (enabled) or *Off* (disabled). 6. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.
How do I enable and change the alarm volume settings for Fetal Heart Rate 1?	1. Rotate the Trim Knob to highlight the legend for FHR1. (This legend is top left on the display, and it may read *INOP*, *FECG*, *US*, or *US2*.) 2. Once the FHR1 legend is highlighted, press the Trim Knob. The display changes to show the <MODE> Setup screen, where <MODE> is the current legend. 3. Now rotate the Trim Knob to highlight the FHR1 *Audio Alarms:* setting. This is at the bottom of the flat panel display, slightly above the menu bar, on the left half of the screen. The setting is either *On* or *Off*. If the setting is *Off*, it needs to be enabled. Proceed to (Step 4) below. If it is already *On*, and you simply wish to change the *Volume*: setting, proceed to (Step 7) below. 4. Once the *Audio Alarms:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting to *On*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Volume*: setting which is located immediately to the right. The setting is in the range of *1* to *9*. 8. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, is emitted from the speaker. 9. Now rotate the Trim Knob to change the current setting, as desired. Each time you change a setting, you will hear an audio tone, indicative of the alarm volume, emitted from the speaker. 10. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 11. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 12. Press the Trim Knob again to return to the main monitoring display screen.

Question	Answer
How do I enable or change alarm volume settings for Fetal Heart Rate 2?	1. Rotate the Trim Knob to highlight the legend for FHR2. (This legend is top left on the display, and may display as *INOP* or *US2*. 2. Once the FHR2 legend is highlighted, press the Trim Knob. The display changes to show the <MODE> Setup screen, where mode is the current legend. 3. Now rotate the Trim Knob to highlight the FHR2 *Audio Alarms:* setting. This is at the bottom of the flat panel display, slightly above the menu bar, on the left half of the screen. The setting is either *On* or *Off*. If the setting is *Off*, you must enable it. Proceed to (Step 4) below. If the setting is already *On*, and you simply wish to change the *Volume*: setting, proceed to (Step 7) below. 4. Once the *Audio Alarms:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting to *On*. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Volume*: setting located immediately to the right. The setting is in the range of *1* to *9.* 8. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, will be emitted from the speaker. 9. Now rotate the Trim Knob to change the current setting as desired. With each setting change, an audio tone, indicative of the alarm volume, will be emitted from the speaker. 10. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 11. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 12. Press the Trim Knob again to return to the main monitoring display screen.
How do I enable or change alarm volume settings for Non-Invasive Blood Pressure?	1. Rotate the Trim Knob to highlight the legend for *NIBP*. (This legend is slightly above center, on the left side of the display.) 2. Once the *NIBP* legend is highlighted, press the Trim Knob. The display changes to show the *NIBP Setup* screen. 3. Now rotate the Trim Knob to select (highlight) the *Volume*: setting which is located immediately to the right. The setting is in the range of *1* to *9.* 4. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, is emitted from the speaker. 5. Now rotate the Trim Knob to change the current setting as desired. Each time you change a setting, an audio tone, indicative of the alarm volume, will be emitted from the speaker. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.

Question	Answer
How do I enable or change alarm volume settings for MHR/P (Maternal Pulse)?	1. Rotate the Trim Knob to highlight the legend for *MHR/P*. (This legend is located approximately in the center of the display, and may indicate *MECG*, *Pulse* or *INOP*, depending on the settings that are currently enabled. 2. Once the *MHR/P* legend is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. Now rotate the Trim Knob to select (highlight) the *Alarm Volume*: setting located immediately to the right. The setting is in the range of *1* to *9.* 4. Once the *Alarm Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, is emitted from the speaker. 5. Now rotate the Trim Knob to change the current setting as desired. With each setting change, an audio tone, indicative of the alarm volume, will be emitted from the speaker. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.
How do I enable or change alarm volume settings for Maternal Blood Oxygen Saturation ($MSpO_2$)?	1. Rotate the Trim Knob to highlight the legend for *$MSpO_2$*. (This legend is located slightly above center, on the right side of the display.) 2. Once the *$MSpO_2$* legend is highlighted, press the Trim Knob. The display changes to show the *$MSpO_2$ Setup* screen. 3. Now rotate the Trim Knob to select (highlight) the *Alarm Volume*: setting which is located immediately to the right. The setting is in the range of *1* to *9*. 4. Once the *Alarm Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video, and an audio tone, indicative of the alarm volume, is emitted from the speaker. 5. Now rotate the Trim Knob to change the current setting as desired. With each setting change, an audio tone, indicative of the alarm volume, will be emitted from the speaker. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. A final audio tone, indicative of the alarm volume, is emitted from the speaker. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.

Question	Answer
How do I change the volume for FHR1 audio or heart beat tones?	Option 1 1. Use the front panel **Volume** Up or **Volume** Down buttons (left) to control volume for FHR Channel 1. Option 2 1. Rotate the Trim Knob to highlight the legend for FHR1. (This legend is top left on the display, and it may read *INOP*, *FECG*, *US*, or *US2*. However, to be able to alter the volume with this method, you must enable one FHR1 mode by inserting a transducer into the appropriate receptacle on the front of the monitor.) 2. Once the FHR1 legend is highlighted, press the Trim Knob. The display changes to show the <MODE> SETUP SCREEN, where mode is the current legend. 3. Now rotate the Trim Knob to highlight the FHR1 *Volume*: setting which is located slightly above vertical center, on the left, next to the volume bar graph. 4. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value between 0 and 9. As the setting is changes, the bar graph changes to reflect the current setting. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.
How do I change the volume for FHR2 audio or heart beat tones?	Option 1 1. Use the front panel **Volume** Up or **Volume** Down buttons (right) to control volume for FHR Channel 2. Option 2 1. Rotate the Trim Knob to highlight the legend for FHR2. (This legend is top left on the display, and it may read *INOP* or *US2*. However, to be able to alter the volume using this method, you must enable one FHR2 mode by inserting a transducer into the appropriate receptacle on the front of the monitor) 2. Once the FHR2 legend is highlighted, press the Trim Knob. The display changes to show the <MODE> SETUP SCREEN, where mode represents the current legend. 3. Now rotate the Trim Knob to highlight the FHR2 *Volume*: setting which is located slightly above vertical center, on the left, next to the volume bar graph. 4. Once the *Volume*: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value between 0 and 9. As the setting changes, the bar graph changes to reflect the current setting. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.

Question	Answer
How do I change the volume for MHR Pulse tones?	1. Rotate the Trim Knob to highlight the legend for *MHR/P*. (This legend is located near the center of the display, and may indicate *MECG*, *Pulse* or *INOP*, depending on the settings that are currently enabled. 2. Once the *MHR/P* legend is highlighted, press the Trim Knob. The display changes to show the *MHR/P Setup* screen. 3. In the *MHR/P Setup* screen, rotate the Trim Knob to highlight *Volume:* setting. This setting is at the vertical center in the left half of the display, next to the *Volume:* bar graph. 4. Once the *Volume:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value between *0* and *9.* As the setting changes, the bar graph changes to reflect the current setting. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.
How do I change the volume for NIBP completion indication?	1. Rotate the Trim Knob to highlight the legend for *NIBP*. (This legend is slightly above center, on the left side of the display. 2. Once the *NIBP* legend is highlighted, press the Trim Knob. The display changes to show the *NIBP Setup* screen. 3. In the *NIBP Setup* screen, rotate the Trim Knob to highlight the *NIBP Done Vol:* setting. This setting is slightly above vertical center, in the right half of the display, next to the *NIBP Done Vol:* bar graph. 4. Once the *NIBP Done Vol:* setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current volume setting. Select a value between *0* and *9.* As the setting changes, the bar graph changes to reflect the current setting. With each change, an audio tone, that reflects the selected audio level, is heard. 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring display screen.

Question	Answer
How do I change the interval time for taking Non-Invasive Blood Pressures?	1. Rotate the Trim Knob to highlight the legend for *NIBP*. (This legend is slightly above center, on the left side of the display.) 2. Once the *NIBP* legend is highlighted, press the Trim Knob. The display changes to show the *NIBP Setup* screen. 3. Now rotate the Trim Knob to highlight the Mode: setting which is below the *NIBP Setup* title. The current setting is one of the following: *Manual, Auto 1 min, Auto 2 min, Auto 3 min, Auto 4 min, Auto 5 min, Auto 10 min, Auto 20 min, Auto 30 min, Auto 40 min, Auto 45 min, Auto 60 min, Auto 90 min,* or *Auto 120 min.* 4. Once the MODE: setting is highlighted, press the Trim Knob again. The current setting displays in blinking inverse video. 5. Now rotate the Trim Knob to change the current setting. Select a value from one of the following: *Manual, Auto 1 min, Auto 2 min, Auto 3 min, Auto 4 min, Auto 5 min, Auto 10 min, Auto 20 min, Auto 30 min, Auto 40 min, Auto 45 min, Auto 60 min, Auto 90 min,* or *Auto 120 min.* 6. Once you set the desired alarm value, press the Trim Knob to confirm your selection. The current value setting stops blinking. 7. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu. 8. Press the Trim Knob again to return to the main monitoring screen.
How do I activate and terminate Heart Rate Offset?	1. Press and hold the Mark [Offset] button (over the recorder) on the front panel of the 250cx Series Monitor for 2 seconds. You will hear a short, two-tone audio beep from the monitor when offset is activated. 2. To end the HR offset period, press and hold the Mark [Offset] button (over the recorder) again for 2 seconds. You will hear a short, two-tone audio beep from the monitor when HR offset is *Off*.
How do I know when the monitor detects Heart Beat Coincidence?	Heart Beat Coincidence (*HBC*) indicates that two HR channels may be monitoring the same signal by placing both heart rates in inverse video on the front panel display, AND by placing a symbol of two overlapping hearts on the trend recorder.
How do I change the date?	1. Rotate the Trim Knob to highlight the *Setup* legend at the bottom of the display, below the menu bar. 2. Once the *Setup* legend is highlighted, press the Trim Knob. 3. The display will change to the *General Setup* screen. 4. In the *General Setup* screen, rotate the Trim Knob to highlight one of the *Date:* setting fields on the top right corner of the display. These fields are for day (DD), month (MMM), and year (YYYY). 5. After the desired field is highlighted (selected), press the Trim Knob. The current setting displays in blinking inverse video. 6. Now rotate the Trim Knob to change the current date parameter setting. 7. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 8. Repeat Step 4 through Step 7 for any other date parameters that need to be set. 9. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu.

Question	Answer
How do I change the time?	1. Rotate the Trim Knob to highlight the *Setup* legend at the bottom of the display, below the menu bar. 2. Once the *Setup* legend is highlighted, press the Trim Knob. 3. The display changes to the *General Setup* screen. 4. In the *General Setup* screen, rotate the Trim Knob to highlight one of the *Time:* setting fields on the top left corner of the display. These fields are for hours (HH), minutes (MMM), and seconds (YYYY). Note that the seconds field cannot be selected or set. 5. After the desired field is highlighted (selected), press the Trim Knob. The current setting displays in blinking inverse video. 6. Now rotate the Trim Knob to change the current time parameter setting. 7. Once you set the desired value, press the Trim Knob again to save the value. The current value setting stops blinking. 8. Repeat Step 4 through Step 7 for any other date parameters that need to be set. 9. Now rotate the Trim Knob to select (highlight) the *Exit* item on the bottom menu.
How do I enable the maternal-only recorder mode?	1. From the *On* state, (The yellow LED above the recorder is illuminated.), press the Record button once quickly. The recorder advances, printing the date and time on the chart paper perpendicular (rather than parallel) to the direction of paper travel. Then the recorder halts and the yellow LED flashes intermittently to indicate MATERNAL ONLY mode is enabled. 2. From the *Off* state, (The yellow LED above the recorder is off), press the Record button twice quickly. The recorder advances, printing the date and time on the chart paper perpendicular (rather than parallel) to the direction of paper travel. Then the recorder halts and the yellow LED flashes intermittently to indicate MATERNAL ONLY mode is enabled.
How do I turn off the recorder completely?	From the *On* or MATERNAL ONLY state, (The yellow LED above the recorder is illuminated or flashing intermittently.), press Record and hold for 2 seconds, until the monitor emits a two tone audio beep which indicates that the recorder is off. The yellow LED is now extinguished.

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